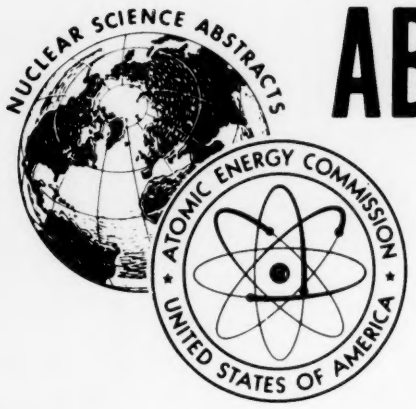
NUCLEAR SCIENCE ABSTRACTS



Volume 28 Number 4

Abstracts 7835-10628

August 31, 1973

UNITED STATES ATOMIC ENERGY COMMISSION

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NUCLEAR SCIENCE ABSTRACTS

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is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
  Gamma-ray production due to neutron interactions with copper for incident neutron energies between 1.0 and 20 MeV: tabulated differential cross sections, 27:21102 (ORNL-4846)

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstract 8205.

7835 (JAERI-1225) ANALYSIS OF SODIUM. (Japan Atomic Energy Research Inst., Tokyo). Jan 1973. 106p. (In Japanese). NTIS (U. S. Sales Only).

Analytical methods are presented for determining trace amounts of impurities, i.e., O, C, H, Cl, B, Al, Ca, Cd, Co, Cr, Fe, K, Li, Mg, Mn, Mo, Ni, U, and V in sodium. Safe-handling techniques for sodium in the laboratory and glove box are reviewed. (auth)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 8199, 8272, and 8312.

7836 (AERE-R-7321) DETERMINATION OF LEAD IN HUMAN RIB BONE. Hislop, H. S.; Parker, A.; Spicer, G. S.; Webb, M. S. W. (Atomic Energy Research Establishment, Harwell (England)). Mar 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

The determination of lead in human rib using emission spectroscopy, atomic absorption, spectrophotometry, and gamma photon activation is described. Certain practical aspects of lead distribution in human rib that may affect the accuracy of the analytical results were studied. (auth)

7837 (IEA-268) ASSOCIATION OF THE METHODS OF ACTIVATION ANALYSIS AND ISOTOPIC DILUTION. Determination of Copper in High Purity Gold Samples. Lima, F. W.; Atalla, L. T. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Apr 1972. 11p. (CONF-690508-5). Dep. NTIS (U.S. Sales Only) $3.00.

From conference on radiation and isotope technology in Latin American development; San Juan, Puerto Rico (4 May 1969).

Activation analysis of impurities in high neutron cross section matrixes is complicated by problems such as neutron flux depression and very high activity levels induced in the matrix, making difficult the handling and processing of the sample. Isotopic dilution method applied to such a sample would avoid the handling of high activities and neutron shadowing problems. Isotope dilution makes necessary the weighing of very small masses to determine specific activity of the substance to be analyzed, after chemical separation. Thermal neutron activation and isotopic dilution methods were combined for the determination of Cu in high-purity Au samples, and thereby avoiding the disadvantages of both methods. (JGB)

7838 SYSTEMATIC ERRORS IN 14-MeV NEUTRON ACTIVATION ANALYSIS FOR OXYGEN. Part II. A General Standardization Method for the Determination of Oxygen. Vandecasteele, C.; Van Grieken, R.; Gijbels, R.; Speecke, A. (Univ., Ghent). Anal. Chim. Acta; 65: No. 1, 1-17(Jun 1973).

A general standardization method is described for the determination of oxygen in solid samples via the $^{16}O(n,p)^{16}N$ reaction. Two systems of flux monitoring are considered: the sample versus standard comparator method and BF_3 monitoring. The average flux in sample and standard, fast neutron shielding, fast neutron scattering, absorption of fast neutrons, absorption of ^{16}N γ-rays and counting efficiency of sample and standard are considered. The influence of the target diameter on the obtained correction factors was also studied. Total achievable accuracy is believed to be about 1%. (auth)

7839 MULTIELEMENT INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL TISSUE USING A SINGLE COMPARATOR STANDARD AND DATA PROCESSING BY COMPUTER. Linekin, D. M. (Massachusetts General Hospital, Boston). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 343-351(Jun 1973).

A detailed description of a multielement instrumental neutron activation analysis approach to routine trace element measurements in biological samples is presented. The main new features of this method are the use of a single element, cobalt, as the comparator standard, and the use of a data smoothing computer technique employing a Fourier transform. A theoretical treatment of the single comparator method is given, along with practical experimental details. A brief description of the computer program with special emphasis on the data smoothing aspects follows. Some results of trace element measurements in biological tissue are then presented, and the paper is concluded by a discussion of the advantages and disadvantages of this approach. (auth)

7840 OPTIMUM PROCEDURE FOR THE DETERMINATION OF SELENIUM IN BIOLOGICAL SPECIMENS USING ^{77m}Se NEUTRON ACTIVATION. Blotcky, A. J.; Arsenault, L. J.; Rack, E. P. (Veterans Administration Hospital, Omaha). Anal. Chem.; 45: No. 7, 1056-1060(Jun 1973).

An optimum procedure is outlined for the rapid quantitative determination of trace ($\geq$ 0.06 μg) selenium in serum and tissue using ^{77m}Se neutron activation. Sample preparation, irradiation procedures, types of detector assemblies, and spectral analyses and data reduction are discussed. The optimum procedure utilizing a low-power nuclear reactor ($\sim 3 \times 10^{11}$ n/cm^2 sec) consisted of irradiating lyophilized tissue samples or dialyzed-lyophilized serum samples for 20 sec, with a 20-sec decay time prior to radioassay. The most suitable radioassay assembly was the 5-mm x 3-in NaI (Tl) detector system. Spectral analyses and data reduction consisted of eliminating the interferences of isotopes of relatively long half-lives by spectrum subtraction and correcting for the $^{23}Ne(^{23}Na(n,p)^{23}Ne)$ and ^{18}O contributions in the region of the ^{77m}Se photopeak. Comparisons between the results obtained by the discussed ^{77m}Se procedure and values quoted for an NBS Bovine Liver Standard were excellent. (auth)

7841 DETERMINATION OF NANOGRAM AMOUNTS OF PALLADIUM IN ROCKS BY NEUTRON ACTIVATION ANALYSIS AND SUBSTOICHIOMETRIC EXTRACTION. Nadkarni, R. A.; Haldar, B. C. (Inst. of Science, Bombay). Radiochem. Radioanal. Lett.; 14: No. 1, 25-34(25 May 1973).

Trace amounts of palladium in several standard rocks were determined by neutron activation analysis. After irradiation palladium is separated by substoichiometrically extracting Pd(II)–2-nitroso-1-naphthol complex into carbon tetrachloride. The substoichiometric extraction with 2-nitroso-1-naphthol was found to be more selective than one with 8-mercaptoquinoline. (auth)

7842 ACTIVATION ANALYSIS OF MINUTE QUANTITIES OF HALOGEN IN ANIMALS AND PLANTS. Yamada, Y. (Kyushu Univ., Fukuoka); Miyaguchi, M. Bunseki Kiki; 10: No. 12, 799-806 (Dec 1972). (In Japanese).

The determination of halogens by activation analysis is described including method of activation, preparation of samples, method of chemical separation, γ ray spectrometry, and examples of application. When the halogen elements are irradiated with thermal neutrons, ^{20}F, ^{36}Cl, ^{38}Cl, ^{80}Br, and ^{128}I are obtained. Activation cross section of ^{19}F is very small, and the half life of ^{20}F is very short, thus the activation analysis of F with thermal neutrons is impossible. Most suited for F is the activation by the

photo-nucleus reaction. Both ^{80}Br and ^{82}Br have long half lives, so there is enough time for chemical separation from other elements. The half lives of ^{38}Cl and ^{128}I are short; therefore, it is necessary to separate these elements rapidly by a simple method. Determination of thyroxine in human blood serum was successfully made by the present method. Inorganic I in urea was also determined by this method. (JA)

7843 DETERMINATION OF OXYGEN BY ACTIVATION ANALYSIS. Schmitt, B. F. (Bundesanstalt fur Materialpruefung, Berlin). Erzmetall; 26: No. 2, 78-81(1973). (In German).

From joint meeting of analytical chemists; Duesseldorf, Germany (3 Jun 1971).

The neutrons produced in neutron generators are sufficiently energetic to activate oxygen in the nuclear reaction $^{16}O(n,p)^{16}N$. The 6.1 and 7.1 MeV gamma quanta of nitrogen-16 are utilized for the measurement. The activation together with the respective measurement takes 1 min and allows to determine the oxygen content down to 0.1 mg of oxygen in a sample of 4.5 cm^3. The detection limit can be further lowered by two orders of magnitude when the γ,n-reaction is applied by means of a linear accelerator. (GE)

Chemical and Spectral Procedures

Refer also to abstracts 8301 and 8664.

7844 (HEDL-TME-72-87) MODIFIED DISSOLUTION AND COULOMETRIC TITRATION PROCEDURE FOR THE ANALYSIS OF PLUTONIUM-URANIUM MIXED OXIDE. Scott, F. A. (Hanford Engineering Development Lab., Richland, Wash.). Nov 1972. Contract AT(45-1)-2170. 20p. AT $4.00.

A new procedure was developed and tested at HEDL for the dissolution of mixed plutonium-uranium oxide samples used for analysis. The most important feature of the new procedure is the use of a perchloric acid fume step which completely removes the hydrofluoric and nitric acids used to dissolve the sample. (auth)

7845 (JAERI-M-5094) SPECTROPHOTOMETRIC DETERMINATION OF BORON, COPPER, AND TANTALUM IN NICKEL-BASE ALLOYS. Toita, Y.; Nagai, H.; Sekine, K.; Onishi, H. (Japan Atomic Energy Research Inst., Tokyo). Jan 1973. 17p. (In Japanese). NTIS (U. S. Sales Only).

Boron (over a few ppM) is determined by Hayes and Metcalfe's curcumin method after separation by methanol distillation. Two procedures were contrived for copper. One is extraction-photometry of copper diethyldithiocarbamate with EDTA for masking; down to 0.003% of copper can be determined. The other procedure is extraction-photometry of the copper(I)-2,2'-biquinolyl chelate; down to 0.002% can be determined. In the former case, absorbance of the extract decreases with time, however. The determination of tantalum (down to 0.004%) is made by the extraction-photometry of Methylene Blue fluorotantalate. Before determination, tantalum is separated by methyl isobutyl ketone extraction from hydrochloric-hydrofluoric acid solution. (auth)

7846 (K-1843) MASS SPECTROMETRIC ANALYSIS OF KRYPTON AND XENON IN LOW CONCENTRATIONS. Horton, J. C. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 7 Jun 1973. Contract W-7405-eng-26. 8p. Dep. NTIS $4.00.

Krypton and xenon were determined by mass spectrometry in concentrations as low as 0.1 ppM in the presence of air components and halocarbons. Nitrogen, oxygen, and halocarbons were removed by exposing the samples to hot titanium sponge, enabling the remaining inert gases to be measured with a 100-fold increase in sensitivity. (auth)

7847 (N-73-14115) DETERMINATION OF HYDROGEN, CARBON, AND NITROGEN IN PLUTONIUM METAL BY A COMBUSTION TECHNIQUE AND OF HYDROGEN BY A HOT EXTRACTION TECHNIQUE. Alm, K. F.; Andersson, L. H. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Oct 1972. 9p. (ISBN-91-7056-17-X). NTIS.

A combined hot-extraction and combustion method for the determination of hydrogen, carbon, and nitrogen in plutonium metal is described. Loosely bound hydrogen is determined in a first (hot-extraction) step, in which the plutonium sample is heated to 900°C in a stream of pure argon. In the second (combustion) step oxygen is added to the gas stream. Heating of the sample is done in a furnace placed in a glove box. The hot-extracted hydrogen is determined with a catharometer. The combustion products, water, carbon dioxide, and nitrogen, are sorbed in columns of molecular sieve, from which they are subsequently released in a controlled way and determined in a gas chromatograph. The limit of detection was found to be the order of 0.01 micrograms of hydrogen, 0.5 micrograms of carbon, and 0.2 micrograms of nitrogen. (STAR)

7848 (UCID-16198) SIMULTANEOUS DETERMINATION OF CARBON, HYDROGEN, AND NITROGEN IN ORGANIC COMPOUNDS. Stump, R. K.; Frazer, J. W. (California Univ., Livermore. Lawrence Livermore Lab.). 18 Jan 1973. Contract W-7405-eng-48. 7p. Dep. NTIS $3.00.

A simple analyzer incorporating a variable-temperature condensation trap and operating under computer control was constructed for C, H, and N determination in organic compounds. This system requires little maintenance and eliminates the usual problems associated with an elaborate glass vacuum apparatus. Results are accurate within acceptable limits with a relative standard deviation of ±0.10%. (auth)

7849 ATOMIC WEIGHTS AND ISOTOPE ABUNDANCES OF THE ELEMENTS. A Future Concern for the Analytical Chemist. de Bievre, P. (Commission of the European Communities, Geel, Belg.). (1972). vp.

From first European conference on analytical chemistry; Heidelberg, Germany (28 Aug 1972).

Through refinement of measuring techniques, the accuracy of a number of atomic weights and natural abundances could be increased, but for a large number the accuracy was decreased. Almost all values of atomic weights were modified in the last 15 yrs. A survey of the atomic weights (shown in a table) and the isotopic abundance of the elements is given. (GE)

7850 DETERMINATION OF TELLURIUM IN COPPER WIRE BY THE METHOD OF VACUUM ATOMIC ABSORPTION SPECTROMETRY. Jedrzejewska, H. (Inst. of Non Ferrous Metals, Gliwice, Poland). Chem. Anal. (Warsaw); 18: No. 1, 117-124 (1973). (In Polish).

The most favorable conditions for determination of tellurium with an atomic absorption spectrophotometer SP 90A (Pye Unicam) were examined. At the resonance line 214.3 nm, with air-acetylene flame as atomizer, at a constant flow-rate of air of 5 dm^3/min, the optimum was achieved at the flow-rate of acetylene of 1.2 dm^3/min, at the burner height of 6 mm, and at the spectral slit-width of 0.4 mm. At these conditions, the sensitivity reached its maximum, and no spectral interferences were stated either from absorption or from emission-lines of copper or accompanying impurities. The additional, preliminary extraction of tellurium as chloride complex, with methyl isobutyl ketone, from the solution in hydrochloric acid, has enabled concentration of traces of tellurium improving the detectability considerably. The highest efficiency of extraction, that of 98%, was achieved from solutions 4 M in hydrochloric acid. The detectability for tellurium in copper is of the order of 10^{-5}%. (auth)

7851 SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF RUTHENIUM WITH O-TOLIDINE. De Pablo, R. S. (Diamond Shamrock Corp., Painesville, OH). Anal. Chim. Acta; 65: No. 1, 213-215(Jun 1973).

A spectrophotometric method for the determination of ruthenium based on the reaction of o-tolidine with ruthenium tetroxide is presented. Beer's law was obeyed over the range 0 to 10.8 μg Ru. The reagent blank was ca 0.010 absorbance units. The sensitivity was about 10^{-3} μg/cm^2. Under the recommended conditions, osmium is the only likely interfering element. (DHM)

7852 O-HYDROXYTHIOBENZHYDRAZIDE: A SELECTIVE REAGENT FOR THE SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM. Shome, S. C.; Gangopadhyay, P. K. (Presidency Coll., Calcutta). Anal. Chim. Acta; 65: No. 1, 216-219 (Jun 1973).

A spectrophotometric method for determining ruthenium is described using o-hydroxythiobenzhydrazide, a compound that is unique in the sense that it is suitable for the determination of microamounts of ruthenium in the presence of large amounts of other platinum metals. o-Hydroxythiobenzhydrazide in hot solution forms a purple complex with ruthenium(III), which is only partially extractable in chloroform but is completely soluble in 20% ethanol. For quantitative development of the color, the optimal acidity ranges between 3.0 M and 9.0 M in hydrochloric acid. The aqueous ethanolic solution of the complex shows maximal absorbance at 540 nm and Beer's law is obeyed over the range 0.44 to 8.8 μg Ru ml^{-1}. (DHM)

7853 CHEMICAL LABORATORY OF THE D. I. E. M. AT ANDUJAR. Garcia Arnedo, J. Energ. Nucl. (Madrid); 17: No. 81, 5-20(1973). (In Spanish).

The creation of the laboratory and its mission are described first. Then its status at the time of the writing of the article is described including the amplification of its objectives. The materials of construction and the laboratory power system are discussed. In the next part there is a discussion of the analyses that have been carried out during the almost 15 years of uninterrupted work that have elapsed and the procedures for the almost 250,000 determinations that have been done. Finally there is a study of the analytical methods used for U and Cu giving special attention to the

use of spectrophotometry. Included are 70 bibliographic citations concerning the procedures used. (tr-auth)

7854 PULSED COLUMN REDOX TECHNIQUES WITH FLEXIBLE FOAM FILLINGS. Braun, T.; Farag, A. B. (Lorand Eoetvoes Univ., Budapest). Anal. Chim. Acta; 65: No. 1, 139-145(Jun 1973).

The analytical utility of chloranil-loaded polyurethane foam in a syringe column was investigated. A rapid method for the determination of micro and semimicro amounts of cerium(IV), vanadium(V), and iron(III) by means of this redox "pulsed" column was developed. The effects of number of pulses, temperature and concentration of metal ion in solution on the reduction efficiency of the proposed pulsed column were critically studied. Analyses for different concentrations of Ce(IV), V(V), and Fe(III) were successfully carried out with an average relative error of ±2.2%. (auth)

7855 DUAL-WAVELENGTH SPECTROPHOTOMETRY. Part IV. Qualitative and Quantitative Analysis by Means of First-Derivative Spectra. Shibata, S.; Furukawa, M.; Goto, K. (Government Industrial Research Inst., Nagoya, Japan). Anal. Chim. Acta; 65: No. 1, 49-58(Jun 1973).

Derivative spectrophotometry has many important applications, e.g. detecting trace chemicals in mixture and analyzing isomers or turbid samples, but such measurements have been difficult instrumentally. The first-derivative spectrum can be recorded easily by using dual-wavelength measurements if the two wavelengths λ_3 and λ_2 are set very close to each other (usually 1–2 nm apart) and scanned simultaneously. Practical applications of derivative spectra in the analysis of rare earths and phenol mixtures are described. (auth)

7856 SAMPLE PREPARATION FOR THE NITROGEN ISOTOPE ANALYSIS BY THE NOI-4 EMISSION SPECTROSCOPE. Keeney, D. R.; Tedesco, M. J. (Univ. of Wisconsin, Madison). Anal. Chim. Acta; 65: No. 1, 19-34(Jun 1973).

A sample preparation unit was developed for use in emission spectrometric analysis of ^{15}N, and the unit and the NOI-4 spectroscope were evaluated. The sample preparation unit was designed to permit use of reusable discharge tubes, monitoring of pressure in the tube, and flushing with and addition of an inert gas to the tube. It utilizes the hypobromite oxidation approach for production of nitrogen gas. Instrument problems and sources of error included nonlinear gain settings, baseline determination, overlapping bandheads and nonlinearity of the standard curve. Problems in the sample preparation method adopted were limited to memory in the discharge tube; this was reduced by prolonged baking of the tubes at 700°C. Minimum sample size is about 10 μg N. In the normal to 5 atom% ^{15}N range, the overall method (sample preparation and analysis) gave 0.01 confidence intervals of ±0.03 atom% ^{15}N. (auth)

7857 FRUITS AND FRUIT PRODUCTS. Control of Authenticity of Fruit Juices by Isotopic Analysis. Bricout, J. (Institut de Recherches Appliquees aux Boissons, Montreuil, France). J. Ass. Offic. Anal. Chem.; 56: No. 3, 739-742(May 1973).

In order to differentiate a natural fruit juice from a dilute concentrate, the isotopic composition of their water was investigated. The stable isotopes deuterium and ^{18}O were chosen for study. The water of orange juices is strongly enriched in heavy isotopes, as compared to rain water. This enrichment is much lower for French apple juices and seems to be due to evapotranspiration. The relationship between deuterium and ^{18}O observed for meteoric water is modified in the fruits. If a fruit juice is concentrated and then rediluted with natural water, the isotopic composition of its water would be very similar to the original deuterium and ^{18}O content of the dilution water. Isotopic analysis clarifies the distinction between natural fruit juices and reconstituted juices. (auth)

7858 COMPARISON OF THE SPADNS–ZIRCONIUM LAKE SPECIFIC ION ELECTRODE METHODS OF FLUORIDE DETERMINATION IN STACK EMISSION SAMPLES. MacLeod, K. E.; Crist, H. L. (National Environmental Research Center, Research Triangle Park, NC). Anal. Chem.; 45: No. 7, 1272-1273(Jun 1973).

Results of a study to assess the equivalence of the specific ion electrode (SIE) and SPADNS methods for the determination of soluble fluoride in emission samples from phosphate fertilizer and aluminium reduction plants are presented. The data presented indicate that the determination of soluble fluoride from phosphate fertilizer and aluminium reduction plants by the specific ion electrode gives results which are essentially equivalent to the SPADNS-Zirconium Lake procedure and which require much less analysis time (7 vs. 70 min/sample). (auth)

7859 MEASUREMENT OF ZIRCONIUM–HAFNIUM RATIOS IN GEOLOGICAL SAMPLES BY ELECTRON IMPACT MASS SPECTROMETRY. Leary, J. J.; Tsuge, S.; Isenhour, T. L. (Univ. of North Carolina, Chapel Hill). Anal. Chem.; 45: No. 7, 1269-1271(Jun 1973).

A new method is described for measuring the Zr/Hf ratio in rocks and minerals. The steps in the analysis include dissolution of the sample, conversion of the metals to volatile chelates, and finally mass spectral analysis with a double focusing mass spectrometer equipped with peak-switching facilities and a computerized integrator. By this method the Zr/Hf ratio can be determined with a precision of about 2%, measured as the relative standard derivation of the mean. (auth)

7860 DETERMINATION OF NITROGEN-15 BY CHEMICAL IONIZATION MASS SPECTROMETRY. Lundeen, C. V.; Viscomi, A. S.; Field, F. H. (Rockefeller Univ., New York). Anal. Chem.; 45: No. 7, 1288-1290(Jun 1973).

The analytical determination of ^{15}N often involves the conversion of the nitrogenous compound containing ^{15}N to ammonia by acid digestion under Kjeldahl conditions followed by oxidation of the NH_3 to N_2 with an appropriate oxidizing agent (alkaline hypobromite) (1-5). The ^{15}N content of the nitrogen gas is then determined using an appropriate technique, which is often electron ionization. A technique is presented for determining ^{15}N using isobutane chemical ionization mass spectrometry. It has the advantage of simplicity and the requirement of only small amounts of original material. The method is based upon the fact that ammonia is easily protonated by the tert-butyl ion in isobutane chemical ionization mass spectrometry to produce the NH_4^+ ion, but water is not protonated by the tert-butyl ion to produce the H_3O^+ ion. As a consequence, the relative amounts of ^{15}N and ^{14}N in ammonia containing both of these isotopes are obtained simply from the intensities of the m/e 18 and 19 ions produced when ammonia is introduced into the mass spectrometer. The ammonia to be measured is produced from the original nitrogenous material by an acid digestion and is absorbed on solid stearic acid. The stearic acid is then placed in the solids introduction probe of the mass spectrometer and heated to release the absorbed NH_3. Average deviation of the results is 11%. (JGB)

7861 MIXED-BED ION-EXCHANGE PAPERS. Hooton, K. A. H.; Parsons, M. L. (Arizona State Univ., Tempe). Anal. Lett.; 6: No. 5, 461-464(May 1973).

Retention of some cations and anions on ion-exchange resin-loaded disks has been reported to be less than quantitative. A mixed-bed resin-loaded paper was made in which mixed cation-exchange and anion-exchange resins were incorporated into the paper to take advantage of the "crossed equilibria" effect and improve ion retention. The use of mixed-bed paper disks in analysis for cesium by x-ray fluorescence spectrometry is described. (auth)

7862 MASS-SPECTROMETRIC DETERMINATION OF URANIUM AND PLUTONIUM BY THE ISOTOPE DILUTION METHOD. Krtil, J. (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 19: No. 4, 121-124(Apr 1973). (In Czech.).

One of the most precise methods for the determination of uranium and plutonium especially in irradiated nuclear fuels is reviewed. The principles for performing the analysis, equations for the calculation, and errors of the methods are discussed. (auth)

7863 SPECTROCHEMICAL DETERMINATION OF RARE AND TRACE ELEMENTS IN EXTRACTS OF ELECTROLYTIC MUDS. Matherny, M.; Reitznerova, E. (Vysoka Skola Technicke, Kosice, Czech.). Zb. Ved. Pr. Vys. Sk. Tech. Kosiciach; No. 2, 109-116 (1970).

Ag, As, Au, Bi, Cu, Ni, Pb, Sb, and Te were determined in extracts of electrolytic muds by atomic emission spectrography. The extracts were filtered: 10 to 20 ml of the filtrate was mixed with 5 ml 1% $Co(NO_3)_2$ solutions and diluted to 25 ml with H_2O. This solution was analyzed in a capillary electrode. The element concentrations were evaluated on the basis of statistical treatment of scatter diagrams, the calibration curves, and given detection limits. The relative standard deviation was ±7 to 15%, the detection limits were 5×10^{-2} to 3×10^{-4} mg/ml. (Selenium-Tellurium Abstr.)

7864 SAMPLING AND ANALYSIS OF ATMOSPHERIC SULFUR COMPOUNDS FOR ISOTOPE RATIO STUDIES. Forrest, J.; Newman, L. (Brookhaven National Lab., Upton, NY). Atmos. Environ.; 7: No. 5, 561-573(May 1973).

A method was developed for sampling atmospheric oxides and for processing the samples for the determination of stable sulfur isotope ratios. Milligram quantities of oxides were collected with high volume sampler packs consisting of glass fiber filters to retain particulate sulfate and alkaline impregnated papers which absorbed sulfur dioxide. Pretreatment has reduced filter blanks to reasonable levels. The effect of concentration, temperature and humidity upon sampling efficiency is described. Various types and grades of particulate filters showed a wide range of adsorption of

sulfur dioxide with formation of extrinsic sulfate. Modified procedures developed for treating small samples produced pure sulfur dioxide for mass spectrometry. Sulfur concentrations were measured during sample preparation by a ^{110}Ag tracer technique. (auth)

7865 DETERMINATION OF THORIUM IN TITANIUM AND ZIRCONIUM CONCENTRATES. Pakalns, P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Anal. Chim. Acta; 65: No. 1, 223-226(Jun 1973).

A spectrophotometric method for determining thorium in titanium and zirconium using Arsenazo-III is presented in which Aliquat-336 is used for the extraction of titanium from hydrochloric acid. The extraction coefficient of 150 for Zr from 10 M HCl is sufficiently high for most of the Zr to be extracted into the organic phase. The remaining traces of Zr can be masked with oxalic acid. (DHM)

7866 KHIMICHESKII ANALIZ METALLURGICHESKIKH FLYUSOV. (Chemical Analysis of Metallurgical Fluxes). Zhalybina, V. D.; Yakovlev, P. Ya.; Kovalenko, O. A. Moscow; Metallurgiya (1973). 176p.

Procedures for chemical analyses of electro-steel and welding fluxes for their chief components are recommended. The most accurate assay methods for 26 elements are described in detail: Si, Al, Fe, K, Mg, Ba, F, C, S, P, Mn, Cr, V, Ti, Zr, B, Ce, Nb, and several nonferrous metals which might be present as impurities. Methods for Zr include precipitation of the phenylarsenate, Complexon III, and photometry with Arsenazo III. Methods for Ce include photometry and titrimetry. The method given for Nb involves photometry with phenylarsonic acid. (KSW)

7867 APPLICATION OF IONIC ELECTRODES TO CATALYTIC ANALYSIS. Kataoka, M.; Kambara, T. (Hokkaido Univ., Sapporo). Bunseki Kiki; 10: No. 12, 773-778(Dec 1972). (In Japanese).

A definite amount of H_2O_2 solution is added to H_2SO_4 or HCl, and diluted with redistilled water. The solution is heated to a definite temperature. After the addition of the KI solution and the sample catalyzer solution, the volume of the solution is made exactly 50 ml by dilution with redistilled water. An ionic electrode and a saturated calomel electrode are dipped in this solution. Stirring the solution, the potential is measured for 11 minutes. By the use of calibration curves, the tungsten(VI) and molybdenum(VI) were determined. Ranges of the determination were 0.144 to 2.09 μg/ml and 0.22 to 2.31 μg/ml for W and Mo, respectively. The presence of a large amount of Mo(VI), Zr(IV), V(IV), Th(IV), Fe(III), and Tl(I) interfered with the determination of W by catalytic action. Indication of the potential of the ionic electrode was varied by the presence of S^{2-} and reducing substances. Coexistence of various anions such as NO_3^-, SO_4^{2-}, SCN^-, CN^-, etc., affected little, when concentration of these ions in the solution was about same as that of the ions to be determined. (JA)

7868 SPECTROPHOTOMETRIC DETERMINATION OF STRONTIUM IN THE PRESENCE OF LARGE AMOUNTS OF BARIUM WITH CHLOROPHOSPHONAZO III [3,6-BIS-(4-CHLORO-2-PHOSPHONOPHENYLAZO)CHROMOTROPIC ACID]. Lukin, A. M.; Chernysheva, T. V. Tr., Vses. Nauch.-Issled. Inst. Khim. Reaktivov Osobo Chist. Khim. Veshchestv; No. 33, 170-173(1971). (In Russian).

For the determination of Sr in barium chloride, dissolve ≈0.18 g of sample in H_2O and dilute to 250 ml. To an aliquot (1 ml) add 0.5 ml of aqueous NH_3–acetate buffer solution of pH 3, 1 ml of H_2O, 2 ml of 1% Na_2SO_4 solution and 0.5 ml of 0.5 mM-chlorphosphonazo III; after 30 min centrifuge the mixture for 3 min. and measure the extinction at 655 nm against a reagent blank. (Anal. Abstr.)

7869 GRAVIMETRIC DETERMINATION OF THORIUM AS ORTHOPERIODATE. Verdizade, A. A.; Grubanov, A. N. Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk; No. 4, 26-30(1970).

To the test solution, containing 0.06 to 42.56 mg of Th, add a 10 to 15-fold excess of a 6% solution of $Na_3H_2IO_6$ in HNO_3 (1 : 1), neutralize the mixture with 4N-NaOH, add a further 5 ml of the NaOH solution, heat for 5 to 10 min. on a sand bath, dilute to 50 ml with hot water, and heat at 70° to 80° for 10 to 15 min. Collect the precipitate, wash it with hot water, dry it at 120° to 130°, and weigh it as $Th_5(IO_6)_4$. The error is ±0.29%. (Ref. Zh.)

7870 DEVICE FOR THE PREPARATION OF SMALL GAS SAMPLES FOR ISOTOPIC ANALYSIS. Besson, Marc; Lucas, M. (to Commissariat a l'Energie Atomique). French Patent 2,129,078. 27 Oct 1972. Filed date 15 Mar 1971. 9p. (In French).

A device is presented for the preparation of small UF_6 gas samples in view of the isotopic analysis of U. It consists of a reactor provided with an annealed electrolytic Cu tube closed at its lower end and having an upper end in the form of a collar, a transfer line (in the form of a Cu tube joined to the reactor by a collared end), a pumping line in the form of a stainless steel T-tube connected to the transfer line, the body of the valve, and the general pumping circuit, a valve provided with a membrane and an Al clapper, and a storage vessel connected to the bottom end of the body of the valve. (Fr)

7871 DETERMINATION OF SMALL QUANTITIES OF TITANIUM AND ^{232}Th IN BIOLOGICAL MATERIAL IN THE PRESENCE OF RARE EARTH ELEMENTS, Nb, Ta, Al, SiO_2, AND OTHER ELEMENTS. Mal'tseva, M. M. Gig. Sanit.; No. 2, 67-69(Feb 1973). (In Russian).

A sensitive, selective, and accurate method was developed for determining Ti and Th in the presence of each other and in the presence of impurities contained in biological materials (Nb, Ta, SiO_2, Al). The method is based on complex formation with dianti-pyrylmethane, with a maximum optical density at acidities from 0.5 to 4 N H_2SO_4. The chief interfering ion, Fe^{3+}, was first reduced to Fe^{2+} by means of ascorbic acid. The sensitivity of the method was 3.5 μg Ti and 0.3 μg Th in 10 g of biological material. (KSW)

Radiometric and Radiochemical Procedures

Refer also to abstracts 8141, 8228, 8270, 8420, 8829, and 9607.

7872 (BNWL-1651(Pt.1), pp 103-104) ANALYTICAL PROCEDURES FOR MEASUREMENT OF ^{214}Pb AND ^{214}Bi IN RAINWATER. Thomas, C. W.; Young, J. A.; Wogman, N. A. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

A technique is described for the rapid continuous separation of ^{214}Pb and ^{214}Bi from samples of rainwater at flow rates of up to 30 l/min. The filtered rainwater is pumped through an anion exchange bed where ^{214}Bi is removed at greater than 90% efficiency. The ^{214}Bi activity is counted immediately. Greater than 90% of the ^{214}Pb is retained on the cation exchange bed, which is set aside for about one hour to allow ingrowth of ^{214}Bi, which is then measured and the concentration of ^{214}Pb is calculated from this growth. (CH)

7873 (SLA-73-512) TRITIUM CONTENT MEASUREMENTS OF LOADED THIN FILMS. Kenna, B. T.; Nelson, G. C. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 27p. Dep. NTIS $3.50.

A technique for determining the tritium content of loaded thin Er films on Mo substrates is described. The interaction of β radiation from the tritium decay with either substrate or thin film produces characteristic x-ray lines and bremsstrahlung radiation. Either intensities of characteristic x-ray lines or integration of selected portions of the spectrum can be correlated with tritium content. The relationship between line spectra and tritium content is the simplest to understand theoretically. Thus, this approach was used to determine tritium concentrations in the range of 0.3 to 23 micron-liters in erbium thin films (areal density 0.2 to 2.3 mg/cm^2) on Mo substrates. The outstanding advantages of this technique are that it is nondestructive in nature, directly determines both areal density and tritium content, assumptions of film densities or film thicknesses are unnecessary, and the analyses can be quickly and easily accomplished. (auth)

7874 USE OF FLUORESCENT RADIATION IN THE MANUFACTURE OF BUILDING MATERIALS. Kominek, A.; Vokac, Z. (Vyzkumny Ustav Stavebnich Hmot, Brno). Radioisotopy; 13: No. 6, 1193-1211(1972). (In Czech).

An evaluation of possibilities and of hitherto achieved results in the determination of elements in silicate materials employed in the manufacture of building materials is presented. Attention is concentrated mainly upon the determination of Al, Si, Ca, and Fe which is carried out by x-ray fluorescence analysis on industrial scale in some czechoslovak cement works. The determination precision of these elements is reported for cement raw materials. (auth)

7875 DETERMINATION OF Mo AND W IN WELDING MATERIALS AND IN STEELS IN GENERAL. Zitnansky, B. (Vyskumny Ustav Zvaracsky, Bratislava). Radioisotopy; 13: No. 6, 1135-1150(1972). (In Czech).

Experiences and results of the use of x-ray fluorescence analysis using ^{109}Cd and ^{147}Pm/Sm for rapid and non-destructive determination of Mo and W in solid samples, castings, overlays, welds, and in powdered samples are reported. The method is very suitable especially for higher contents of these elements—from about 1% to 100%. A multichannel analyzer is used for the determination of particle flux density of the characteristic x-ray radiation. (auth)

7876 CONTINUOUS NICKEL ANALYSIS. Nemcikova, A.; Bumbalova, A.; Havranek, E. (Karlova Univ., Bratislava). Radioisotopy; 13: No. 6, 1121-1134(1972). (In Czech).

In industrial processes, a continuous control of the production process is often required. The possibilities of the use of radionuclide x-ray fluorescence analysis for these purposes are reported. The continuous analysis of NiO suspensions in concentrations from 100 to 300 g/l by the method of selective gamma absorption and solution analysis with the use of TELSEC instruments and the NZQ 713a-T measurement set is described. (auth)

7877 DETERMINATION OF LEAD CONTENT IN GLASS SAMPLES BY ROENTGEN-FLUORESCENT ANALYSIS WITH THE USE OF A Ge(Li) GAMMA DETECTOR. Vejs, M.; Ullman, V. (Inst. of Nuclear Research, Rez, Czech.). Radioisotopy; 13: No. 6, 1105-1120(1972). (In Czech).

A method for the non-destructive determination of lead content in historically valuable glass articles by x-ray fluorescent analysis using a Ge(Li) detector is described. The radionuclides ^{139}Ce and ^{141}Ce have been used as sources of the exciting gamma radiation. The relative precision of measurement of glass samples containing more than 1% of lead is 1 to 2%. (auth)

7878 PHYSICAL PRINCIPLES OF THE ORIGIN OF FLUORESCENT X-RAY RADIATION FOR SPECTRAL ANALYSIS OF MATERIALS. Khol, F. (Ustav Radiotechniky a Elektroniky, Prague). Radioisotopy; 13: No. 6, 1085-1096(1972). (In Czech).

A survey is given of the development of the method of spectral analysis making use of the fluorescent x-ray radiation of elements. The origin of the characteristic radiation is explained and the various methods of excitation and their advantages are discussed. Various methods of spectral analysis of the fluorescent x-ray radiation are described and the methods of quantitative recording of spectral lines are briefly evaluated. A short comparison of the x-ray spectral analysis with the polarographic, colorimetric, and activation method is presented with regard to precision, sensitivity, and purchase costs. (auth)

7879 USE OF X-RAY FLUORESCENT ANALYSIS IN LABORATORY CONDITIONS. Cutkova, O.; Havranek, E.; Bumbalova, A. (Comenius Univ., Bratislava). Radioisotopy; 13: No. 6, 1069-1084 (1972). (In Czech).

Results obtained with the analysis of solutions (I,Br), solids (W), small quantities on a carrier (rare earths, Ba, Ag), and other analytical applications of the method (determination of the end point in precipitation titrations) are presented. Amplitude selection as well as the selection by a couple of Ross differential filters were used for the characteristic radiation selection of the analyzed elements. (auth)

7880 HIGH ENERGY ELECTRON IMPACT IONIZATION. Colle, R. P. Troy, NY; Rensselaer Polytechnic Inst. (1973). 204p. University Microfilms Order No. 73-7389.

Thesis (Ph. D.).

A method has been demonstrated in which the emission of characteristic x-rays following impact ionization by electrons of several MeV energy is used for elemental analysis by energy dispersive x-ray spectrometry. Because of the unique properties of MeV electrons with respect to their x-ray production yield and range in solids, the method has comparable sensitivity over a wide range of elements and does not require stringent sample preparation techniques. By using energy dispersive analysis to detect the x-rays, a simultaneous determination of the weight fraction of the elements in an unknown sample is possible from a procedure based entirely on empirically determined relative x-ray yields. The relative x-ray yields were established from simultaneous measurements of the x-rays from targets containing a known ratio of two elements. The targets were made by dissolving solid samples and adsorbing the solutions onto identical thin adsorbent supporting matrices of either filter paper (8.15 mg/cm^2) or lens tissue (1.35 mg/cm^2). The thinner lens tissue targets were found to be more advantageous in several respects and were therefore used in the majority of the work. Typically, these latter targets contained ~1 mg/cm^2 of sample material. Various detection systems using high resolution liquid nitrogen cooled Ge(Li) and Si(Li) detectors were employed for the studies. For one of the detection systems utilized, the Si(Li) detector was directly vacuum coupled to the evacuated electron beam tube. In this case, it was possible to detect all elements down to aluminum (Z = 13). The method developed for measuring the relative yields and making the elemental assays was shown to be both simple and rapid. The entire procedure requires only relative measurements. All of the measured quantities are obtained from ratios of simultaneously recorded x-ray intensities and weight ratios. It, therefore, does not require any absolute measurements of the number of atoms or the number of x-ray produced. The capability of the method for quantitative analysis was tested by analyzing three standard metal alloy samples obtained from the National Bureau of Standards. Elements ranging from iron (Z = 26) to lead (Z = 82) with concentrations from 0.06% to 88% were quantitatively determined. In general, good approximate agreement with the reported assays was found. For even the minor constituents, the accuracy of the results was of the order of 5 to 10%. Relative cross sections for K-shell ionization by 2.04 ± 0.01 MeV electrons for 31 elements were extracted from the relative Kα X-ray yield measurements. The relative cross sections were combined with the absolute cross section measurement of Rester and Dance for tin at 2 MeV [σ_K(Sn) = 44 ± 4 b] to obtain absolute cross sections for all 31 elements. They are (in barns): V, 361 ± 53; Cr, 277 ± 41; Mn, 276 ± 43; Fe, 261 ± 38; Co, 246 ± 40; Ni, 240 ± 38; Cu, 203 ± 30; Zn, 188 ± 30; As, 138 ± 21; Se, 114 ± 19; Br, 111 ± 12; Rb, 105 ± 15; Sr, 91.2 ± 13.1; Ag, 57.8 ± 5.2; Cd, 46.8 ± 4.1; In, 44.2 ± 4.0; Sb, 42.1 ± 3.7; Te, 38.6 ± 3.4; Ba, 30.9 ± 2.8; La, 19.2 ± 2.5; Ce, 23.6 ± 3.1; Pr, 24.1 ± 3.2; Nd, 22.0 ± 2.0; Sm, 21.1 ± 2.0; Eu, 21.5 ± 3.1; Gd, 21.2 ± 2.0; Er, 16.9 ± 1.6; Yb, 15.6 ± 1.6; Pt, 11.9 ± 1.5; Pb, 10.0 ± 1.2; Bi, 9.5 ± 1.2. (Diss. Abstr. Int., B)

7881 X-RAY ENERGY SPECTROMETRY. Porter, D. E.; Woldseth, R. (Kevex Corp., Burlingame, CA). Anal. Chem.; 45: No. 7, 605A-606A; 608A; 610A; 612A; 614A(Jun 1973).

The x-ray energy spectrometer system consists of a means of excitation (either photon or charged particle), the sample, and the detector ranged in fixed geometry. Applications of the Si(Li) detector x-ray energy spectrometer to nondestructive elemental analyses are described. Advantages of the method as compared with conventional x-ray fluorescence techniques are given. (25 references) (JGB)

7882 SIMPLIFIED METHOD FOR THE DETERMINATION OF LABELED ALKANE HYDROCARBONS IN MAMMALIAN TISSUE AND BLOOD AFTER EXPOSURE TO RADIOLABELED CIGARETTE SMOKE. Rubin, I. B. (Oak Ridge National Lab., TN). Anal. Lett.; 6: No. 5, 387-396(May 1973).

A simplified procedure for the determination of ^{14}C-labeled alkanes in mammalian tissue and blood is proposed. A portion of the ethanol–KOH digest of the sample is counted in a standard toulene scintillator solution; consequently no secondary scintillator solvent or special tissue solubilizer is required. A wide variety of sample types and sizes, including whole organs, can be handled without homogenization or drying. Accuracy and precision are good. Sensitivity is generally inversely related to sample size. (auth)

7883 GLC ANALYSIS OF SOME HIGHLY ACTIVE PLANT RETARDANTS FROM GROUP OF N,N-SUBSTITUTED SUCCINIC ACID HYDRAZIDES LABELED WITH ^{14}C. Vlasakova, V.; Benes, J. (Institutes for Biological Research, Prague). Radiochem. Radioanal. Lett.; 14: No. 1, 43-55(25 May 1973).

A method is described for the determination of esters of dimethylhydrazide of succinic acid by gas-liquid chromatography. Optimum response conditions of the flame ionization detector for the analyzed substances were set. The method is extended for the possibility of the determination of compounds labeled with ^{14}C. The measurement of the radioactivity of the separated compounds was carried out by collection of fractions with an automat and the measurement of the fractions in a scintillation counter. The efficiency of the yield of the total radioactivity introduced was about 95%. (auth)

7884 RADIOACTIVE SOURCES FOR EXCITATION OF X-RAY FLUORESCENT RADIATION. Satorie, Z.; Stopek, K. (Ustav pro Vyzkum, Vyorobu a Vyuziti Radioisotopu, Prague). Radioisotopy; 13: No. 6, 1097-1103(1972). (In Czech).

Radioactive sources for excitation of x-ray fluorescent radiation produced in the Institute for Research, Production, and Use of Radioisotopes are described. (auth)

7885 QUANTITATIVE DETERMINATION OF U CONTENT AND ITS U-235 ENRICHMENT BY COMBINED GAMMA X-RAY FLUORESCENT MEASUREMENTS. Bachvarov, N.; Dragnev, T.; Georgiev, S.; Karamanova, J.; Ruskov, T.; Tomov, T. (Inst. of Physics, Sofia). Radiochem. Radioanal. Lett.; 14: No. 1, 1-8 (25 May 1973).

Combined gamma spectrometry, x-ray fluorescent method using a Ge(Li) detector was developed for quantitative determination of U and its ^{235}U enrichment in thin (less than 0.1 g/cm^2 of U) samples. The 122 keV gamma rays of ^{57}Co were used for excitation of U-K x-rays. (auth)

7886 RADIOMETRIC METHODS OF DETERMINATION OF SMALL QUANTITIES OF CADMIUM IN COPPER. Shamaev, V. L.; Artynov, A. M.; Churilova, M. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 816-818(1972).

Translated from Radiokhimiya; 14: No. 5, 786-788(1972).

The influence of pH and ammonium thiocyanate on the extraction of cadmium using a substoichiometric amount of dithizone was

studied. The possibility of the separation of cadmium and copper by precipitation of the latter with ammonium thiocyanate and complete isolation by extraction with dithizone in acid medium (pH = 1 to 2) was studied. A method of radiometric correction was developed for the determination of Cd by substoichiometric extraction with dithizone for preliminary removal of copper. (auth)

7887 INTERCALIBRATION OF METHODS FOR MEASURING FISSION PRODUCTS IN SEAWATER SAMPLES. Fukai, R.; Ballestra, S.; Murray, C. N. (International Atomic Energy Agency, Monaco). pp 3-27 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From Symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

To examine the present-day comparability of fission product measurements on seawater samples with the aim of achieving better comparability in the future, an intercalibration exercise was organized by the Monaco Laboratory in 1970–71. Two kinds of homogeneous seawater samples contaminated with various radionuclides under natural conditions at monitoring levels were distributed to laboratories around the world and 46 laboratories reported the results of measurements on fission products in these samples. A survey made on the reported results is presented together with the results of homogeneity tests of the samples. The preferred values for ^{90}Sr, ^{137}Cs, ^{134}Cs, and ^{106}Ru were estimated for these samples by statistical treatments of the obtained results. The scatter of the results is less pronounced for ^{90}Sr and ^{137}Cs than for $^{95}Zr-^{95}Nb$, ^{106}Ru, ^{134}Cs, and ^{144}Ce. For ^{106}Ru, in the higher level sample, the results are especially noteworthy, being spread over almost two orders of magnitude. This seems to relate to the incapability of some methods to measure different chemical forms of this radionuclide occurring in seawater. Specific observations made on the results for each radionuclide as well as general remarks on the reported results are also given. (auth)

7888 CHEMICAL ANALYSIS OF RADIOACTIVE NUCLIDES BY COPRECIPITATION. I. Chemical Analysis of Radioactive Nuclides in Seawater by Coprecipitation with Ferric Hydroxide Using Pyridine as precipitant. Koda, Y. (Government Industrial Research Inst., Nagoya, Japan); Iwashima, K.; Koyanagi, T.; Watari, K.; Izawa, M. Radioisotopes (Tokyo); 21: No. 8, 473-477(Aug 1972). (In Japanese).

A method of separation and spectrometric analysis with a NaI(Tl) scintillator of long-lived radionuclides in seawater, to be released from nuclear installations, was investigated. When coprecipitation of the nuclides with hydrated ferric hydroxide was carried out by adding pyridine instead of ammoniacal water, ^{59}Fe, ^{95}Zr, ^{141}Ce, and ^{106}Ru could be coprecipitated with >95% yield, while ^{90}Sr and ^{137}Cs were not precipitated at all. Coprecipitation of ^{60}Co and ^{65}Zn was very little. The results can be explained by the fact that the pH of the solutions at the precipitation could be adjusted to 6 to 7 easily and accurately, and that few of the metal ions formed their pyridine complexes. Experiments with varying the amounts of pyridine and/or Fe added to seawater revealed the coprecipitation behavior of each radionuclide in detail. (auth)

7889 RADIOMETRIC METHOD OF SELECTIVE ANALYSIS TO DETERMINE MICROCONCENTRATIONS OF U, Ra, Th, AND K IN ROCKS. Gohn, E.; Brataseanu, E. Stud. Teh. Econ., Inst. Geol. (Rom.), Ser. D; No. 9, 157-165(1972). (In Rumanian).

A method is described for the determination of U, Ra, Th, and ^{40}K in 2 to 3 kg of powder. Equipment consisted of a 16-channel analyzer, a scintillation sounder with an NaI crystal of 8 × 10 cm, a 10 cm thick Pb screen, and a counting device with a Geiger-Müller meter. The measurement conditions were fixed starting from the relation: $t = f(\sigma_i; v_i; Q_i)$, where σ_i is a standard, v_i the counting rate and Q_i a parameter. (Rom. Sci. Abstr.)

Separation Procedures

Refer also to abstracts 8122, 8169, and 8568.

7890 PREDICTION OF K_{sp} FROM R_f VALUES. Chromatography of 48 Metal Ions on Stannic Arsenate and Plain Papers in Butanol–Nitric Acid Media. Qureshi, M.; Sharma, S. D. (Aligarh Muslim Univ., India). Anal. Chem.; 45: No. 7, 1283-1288(Jun 1973).

The chromatography of 48 metal ion in butanol–HNO_3 systems was studied on plain and ion exchange papers. Included in the ions studied are VO_2^{2+}, Y^{3+}, Zr^{4+}, Ce^{4+}, Ce^{3+}, Th^{4+}, La^{3+}, Ne^{5+}, Hf^{4+}, Sm^{3+}, Pr^{3+}, Nd^{3+}, and Cs^{+}. On the basis of R_f values, the K_{sp} of the arsenates K^+, Rb^+, Cs^+, Tl^+, Y^{3+}, La^{3+}, Ga^{3+}, and Ce^{4+} are predicted. Butanol was chosen because of earlier experience that it gives clean and useful separations. Nitric acid was chosen because it is a noncomplexing-acid, and the understanding of the equilibria is simplified. Results of the study are summarized. (auth)

7891 STUDY OF THE DESORPTION OF NIOBIUM FROM THE ANION EXCHANGERS OF FLUOROFORMS. Brouchek, F. I.; Gudushauri, Ts. N. (Polytechnic Inst., Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 70: No. 1, 85-88(Apr 1973). (In Russian).

The desorption of niobium from the AB-16 and AB-17 anion exchangers of fluoroforms was studied under dynamic conditions. The efficiency of sorbing agents and eluates and the optimal hydrodynamic conditions of elution were ascertained. The use of the AB-16 and AB-17 anion exchangers of fluoroforms for chromatographic separation of niobium was found to be promising. (auth)

7892 SOLVENT EXTRACTION OF TRIVALENT AMERICIUM FROM ACID MEDIA. Myasoedov, B. F.; Chmutova, M. K.; Kochetkova, N. E.; Pribylova, G. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 14: No. 1, 63-67(25 May 1973).

The extraction of americium(III) from 1 to 12M HNO_3 solutions by a mixture of bis(2-ethylhexyl) orthophosphate (D2EHPA) and phosphorus pentoxide (P_2O_5) in cyclohexane was studied. It was found that the extractant suggested extracts americium quantitatively over the whole HNO_3 concentration range. Large amounts of $Al(NO_3)_3$ do not interfere in the extraction of americium with a solution 0.3M in D2EHPA and 0.1M in P_2O_5. (auth)

7893 THERMODYNAMIC EQUILIBRIUM CONSTANTS AND THERMAL EFFECTS OF REACTIONS OF EXTRACTION OF URANYL NITRATE BY TRIALKYL PHOSPHATE IN INERT SOLVENTS. X. Consideration of Hydration of Reagents. Komarov, E. V.; Shpunt, L. B. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 697-702(1972).

Translated from Radiokhimiya; 14: No. 5, 674-680(1972).

The existence of molecular complexes with the composition $(C_nH_{2n-1}O)_3PO \cdot H_2O$ (where n varies from 3 to 10) in dilute solutions of trialkyl phosphates was confirmed. The thermodynamic equilibrium constants of the formation of these complexes were found. It was found that the proposed molecular–statistical model of the chemical reaction well describes the influence of various molecular parameters on the equilibrium of hydration reactions of trialkyl phosphates in inert solvents. The equilibrium constants and thermal effects of reactions of hydration of the reagents were considered in determining the thermodynamic equilibrium constants of the extraction of uranyl nitrate by trialkyl phosphates in carbon tetrachloride and n-decane and the thermodynamic functions ΔH, ΔG, and ΔS of these reactions at t = 25°C. (auth)

7894 POSSIBILITIES OF INCREASING SORPTION OF RADIOACTIVE STRONTIUM BY ALGINATES. Pyatkovskaya, N. A.; Dolmatova, M. Yu. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 685-689(1972).

Translated from Radiokhimiya; 14: No. 5, 663-667(1972).

Preparations of alginic acid differing in monomer composition, molecular weight, and sorption capacity with respect to ^{90}Sr and ^{45}Ca were isolated from two samples of industrial sodium alginate by methods of hydrolysis and fractionation, as well as by a combination of these methods. It was determined that with increasing content of gluconic acid in the alginic acid molecule, the sorption capacity of the preparation is increased. No appreciable influence of the value of the molecular weight of alginate (in the interval 1000 to 37,000) on its sorption capacity was noted. (auth)

7895 COORDINATION CHEMISTRY OF RUTHENIUM IN PROCESSES OF EXTRACTION BY ORGANOPHOSPHORUS COMPOUNDS. I. Extraction of Nitrato Complexes of Nitrosoruthenium. Sinitsyn, N. M.; Travkin, V. F.; Zaivyi, A. D. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 703-708(1972).

Translated from Radiokhimiya; 14: No. 5, 680-686(1972).

The basic principles of the extraction of nitrato complexes of nitrosoruthenium $[RuNO(NO_3)_x(OH)_y \cdot (H_2O)_{5-(x+y)}]^{3-(x+y)}$ by neutral organophosphorus extraction reagents: trialkylphosphine oxides, dialkylphosphine sulfides, and trialkylphosphine selenides, were studied as a function of the nature of the extraction reagent and diluent, the concentration of HNO_3 and Ru, and other factors. The mechanism of extraction is discussed. Nitrato complexes of nitrosoruthenium with molecules of trialkylphosphine oxides of the type of $[RuNO(NO_3)_3(TBPO)_2]$ and $[RuNO(NO_3)_3(TOPO)_2]$ were synthesized and studied by various physicochemical methods. (auth)

7896 COPRECIPITATION OF CERIUM FLUORIDE WITH ISOMORPHOUS SOLID PHASE CRYSTALLIZING FROM FLUORIDE MELTS. Alekseev, V. A.; Klokman, V. R. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 679-684(1972).

Translated from Radiokhimiya; 14: No. 5, 657-662(1972).

The coefficients of crystallization of CeF_3 in the case of its distribution between a melt and crystals of LaF_3 in the systems

LaF_3–MF (where M = Na, K, Rb) in an atmosphere of argon, nitrogen, carbon dioxide, and air, were determined. It was found that the distribution of CeF_3 in the fluoride systems studied occurs according to the Khlopin law. The influence of the temperature and the nature of the flux on the coefficient of crystallization of CeF_3 was explained by a change in the activity of the ions of the micro- and macrocomponents as a result of the formation of fluoride complex compounds of lanthanum and cerium of different strengths. A comparison of the values of the coefficients of crystallization of cerium, praseodymium, and samarium fluorides, produced under the same conditions, shows that the value of the coefficients of crystallization is greater, the smaller the difference in the radii of the ions of the micro- and macrocomponents. It was found that the nature of the inert gas and the time of the experiment have no effect on the isomorphous coprecipitation of cerium fluoride with lanthanum fluoride, in contrast to the cocrystallization of CeF_3 with a nonisomorphous, solid-phase calcium fluoride. (auth)

7897 COMPLEX FORMATION OF AMERICIUM AND EUROPIUM WITH HYDROXYETHYLIDENEDIPHOSPHONIC ACID. Lebedev, I. A.; Mazur, Yu. F.; Myasoedov, B. F. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 782-785(1972).

Translated from Radiokhimiya; 14: No. 5, 759-762(1972).

It was established that in the region of pH = 2.0 –4.0, Am^{3+} and Eu^{3+} form complex ions with hydroxyethylidenediphosphonic acid (HEDPA) of the type of $M(H_3L)_3^{3-}$, with stability constants log β_3 = 11.50 (Am) and 11.70 (Eu) at an ionic strength μ = 0.1. A comparison of the stability constants of complexes of Am^{3+} and Eu^{3+} with various organic ligands shows that complexes of Eu^{3+} with organophosphorus ligands in most cases are stronger than complexes of Am^{3+}, especially in the case of complex formation with several protonated ligands. (auth)

7898 EXTRACTION WITH TRIBUTYL PHOSPHATE FROM HYDROCHLORIC ACID SOLUTIONS. VII. Extraction of Molybdenum. Titkova, T. D.; Levin, V. I. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 779-781(1972).

Translated from Radiokhimiya; 14: No. 5, 757-759(1972).

The dependence of the distribution coefficient of microquantities of molybdenum between 4M (or 8M) HCl and mixtures of TBP with heptane on the TBP concentration was studied. The solvate number of Mo, calculated according to the method of least squares, is equal to 2.02 ± 0.43 and 2.25 ± 0.13 for 4 and 8M HCl, respectively. The extraction of microquantities of molybdenum from solutions of HCl + NaCl by tributyl phosphate was studied. It was found that under the investigated conditions, the extraction of molybdenum occurs in the form of $MoO_2Cl_2 \cdot 2TBP$. The constant of the extraction of this complex $K_{e,l}$ = 1.02 ± 0.05. (auth)

7899 INFLUENCE OF COMPOSITION AND STRUCTURE OF TERTIARY AMINES ON EXTRACTION SEPARATION OF RARE EARTH ELEMENTS OF CERIUM SUBGROUP. Shvedov, V. P.; Kopyrin, A. A.; Stepanov, I. K. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 777-778(1972).

Translated from Radiokhimiya; 14: No. 5, 755-757(1972).

The separation of two pairs of elements, Ce(III) – Pr and Pr – Nd by solvent extraction using various tertiary amines was investigated under equilibrium conditions in the presence of $LiNO_3$. Distribution coefficients and separation factors are tabulated. Results indicate that a change in composition and structure of investigated amines has practically no influence on the effectiveness of the separation of the rare earths. (JGB)

7900 EXTRACTION CAPACITY OF SULFOXIDES. VII. Extraction Separation of Elements by Method of Reversed Phase Paper Chromatography. Rozen, A. M.; Murinov, Yu. I.; Nikitin, Yu. E. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 775-776 (1972).

Translated from Radiokhimiya; 14: No. 5, 754-755(1972).

Paper chromatography was used to evaluate the separation capacity of cyclic sulfoxides for two pairs of elements, Hf – Zr and Se – Te. The coefficient of separation for Ar and Hf is approximately 10 when the stationary phase is a 0.7M solution of 2-heptylthiophane in o-xylene using 2M HNO_3 as the eluent. The coefficient of separation for Te – Se averages 64.4 when the eluent is 2M HCl and 28.3 when the eluent is 2M H_2SO_4 – 2M HCl. (JGB)

7901 EXTRACTION CAPACITY OF SULFOXIDES. VI. Extraction of Tantalum and Niobium by Petroleum and Individual Sulfoxides. Rozen, A. M.; Murinov, Yu. I.; Nikitin, Yu. E.; Abramova, A. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 773-774(1972).

Translated from Radiokhimiya; 14: No. 5, 752-754(1972).

The extraction of tantalum and niobium by individual sulfoxides, as well as by sulfoxides of petroleum origin, was studied. It was found that the solvate number is equal to three. A mechanism of extraction is proposed, and extraction constants are evaluated. It was found that sulfoxides of petroleum origin are close in extraction capacity to cyclic and are effective extraction reagents for rare and scattered metals. It is suggested that sulfoxides of petroleum origin be used for the extraction and separation of niobium and tantalum. (auth)

7902 SORPTION OF Eu, Tm, AND Cm ON ANION EXCHANGE RESIN DOWEX 1X4 FROM SOLUTIONS OF MIXTURE OF LiCl – NH_4CNS – HCl. Bochkarev, V. A.; Lbov, A. A.; Martynov, N. P. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 766-768 (1972).

Translated from Radiokhimiya; 14: No. 5, 746-748(1972).

The distribution coefficients of Eu, Tm, and Cm on the resin Dowex 1X4 were determined, using a mixture of LiCl – NH_4CNS – HCl as the eluent. It was found that the selected eluent (mixture) is substantially more effective for the separation of transplutonium and rare earth elements on an anion exchange resin in comparison with LiCl, NH_4CNS, and HCl, taken individually. At the investigated concentrations of LiCl, HCl, and NH_4CNS, the following conditions can be recommended as most favorable for separation: [LiCl] = 5 M, [NH_4CNS] = 1 M, [HCl] = 0.1 M. The distribution coefficient (K_d of Cm/K_d = Eu) obtained in this case is ~27. (auth)

7903 ION EXCHANGE INTERACTION OF CERTAIN DIVALENT CATIONS WITH ALGINIC ACID. Panteleeva, A. P.; Dolmatova, M. Yu.; Dolmatov, Yu. D. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 760-62(1972).

Translated from Radiokhimiya; 14: No. 5, 741-743(1972).

The distribution coefficients of certain divalent cations, Mn^{2+}, Ni^{2+}, Co^{2+}, Sr^{2+}, and Cu^{2+}, under conditions of static sorption on alginic acid and its calcium – hydrogen form were determined as a function of the conditions of the interaction (pH, temperature). A possible mechanism of the effects that occur, associated with the structural peculiarities of the ion exchangers, is proposed. (auth)

7904 BEHAVIOR OF BERKELIUM IN ITS SEPARATION FROM CERIUM ON AN ANION EXCHANGE RESIN. Shafiev, A. I.; Efremov, Yu. V. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 754-756(1972).

Translated from Radiokhimiya; 14: No. 5, 735-738(1972).

The difference in the behavior of berkelium and cerium during their separation using strongly basic anion exchange resins (for example, Dowex-1) or extraction reagents of the type of trialkylamines, lies not in a special ability of the Bk^{4+} ion for hydration, but in the very rapid transition $Bk^{4+} \rightleftharpoons Bk^{3+}$ during contact with the resin or extraction reagent in the presence of an oxidizing agent. (auth)

7905 ION EXCHANGE BEHAVIOR OF TRIVALENT Am, Cm, Cf, AND OTHER ELEMENTS IN SYSTEM WITH NITRILOTRIACETIC ACID. Elesin, A. A.; Zaitsev, A. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 750-753(1972).

Translated from Radiokhimiya; 14: No. 5, 731-735(1972).

The ion exchange behavior of Am^{3+}, Cm^{3+}, Cf^{3+}, Pm^{3+}, and Eu and other elements in a system with nitrilotriacetic acid was investigated. On the basis of the data on the separation, corrections were introduced into the values of the stability constants of the complexes to bring them into agreement with the results of potentiometric measurements. (auth)

7906 COLLECTOR CONSUMPTION DURING ION FLOTATION OF MOLYBDENUM BY PRIMARY AMINES. Gvozdeva, I. E.; Gol'man, A. M.; Kuz'kin, S. F.; Nebera, V. P. (Moscow Inst. of Steel and Steel Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 26-30(1972). (In Russian).

Consumption of the collector is an important economic factor in ion flotation, especially in view of the high cost of surface-active agents. Experimental data were obtained from an investigation which used the ionic flotation of Mo by cationic collectors as a typical example. A solution of Na_2MoO_4 was used in flotation experiments with several primary aliphatic amines: decyl, lauryl, cetyl, and octadecyl, in 0.2 M alcoholic solutions in which agitation was continued until frothing ceased. Concentrations of Mo and the amine were determined photometrically. A lowered extraction of Mo at high amine consumption was associated with the adsorption of an excess of collector at the bubble surfaces and the particles of sedimentation of the amine polymolybdates. The maximum Mo extraction increased, but the consumption of collector was lowered during an increase in initial Mo concentration and during its passing over to the amine. (KSW)

7907 ZIRCONIUM BEHAVIOR ON CARBOXYL CATION EXCHANGERS. Kazantsev, E. I.; Sapogov, N. V.; Kudryavskii, Yu. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 94-96(1972). (In Russian).

The sorption of Zr from HNO_3 and HCl solutions onto the cation exchanger KB-2 with various divinylbenzene (DVB) contents was studied. The complex character of the adsorption curves (equiva-

lents/g vs pH of the solution) which passed through maxima attested to the presence of hydrolysis and complex formation, both in solution and in the adsorbed phase. Changes in the DVB content of the resin shifted the position of the maximum slightly. (KSW).

7908 TRACES OF YTTRIUM AND LANTHANIDES RADIONUCLIDES IN AQUEOUS SOLUTIONS. II. Desorption of Trace Amounts of Yttrium from Filter Paper. Polansky, P. (Zapotocky Military Academy, Brno); Bar, J. Collect. Czech. Chem. Commun.; 38: No. 4, 1145-1148(Apr 1973).

Trace amounts of the radionuclide ^{91}Y were sorbed on filter paper from aqueous solutions at pH 1.7 to 11.2 and at the temperature of 25°C and their desorption was studied using either aqueous solutions of the same pH values as the sorption solutions or the 10^{-3} M solution of hydrochloric acid. The dependence of the ^{91}Y desorption on the acidity of the desorption (and also sorption) solution showed a monotonous decrease from high values in the strongly acidic media to the rather low and roughly constant values in the alkaline media. For yttrium sorbed in the pH range from 2.9 to 10.2 the desorption gave high values if 10^{-3} M hydrochloric acid was used as the desorbent; for both lower and higher pH values a decrease of desorption was observed. (auth)

7909 COLUMN CHROMATOGRAPHY. 5th International Symposium on Separation Methods, Lausanne, Switzerland, October 7–10, 1969. Kovats, E. Sz. (ed.). Supplementum to Chimia 1970. Aarau, Switzerland; Swiss Chemists' Association (1970). 285p. (In several languages). (CONF-691074-).

From 5th international symposium on separation methods: column chromatography; Lausanne, Switzerland (7 Oct 1969).

Fifty-one papers in nine categories, electrophoresis and chromatography, liquid column chromatography, engineering treatment of chromatography, reaction chromatography, gel permeation chromatography, chromatographic retention data, supercritical fluid chromatography, chromatography of labile and corrosive substances, and miscellaneous, were presented. A separate abstract was prepared for one paper. (DHM)

For an abstract of an individual paper see: 7910.

7910 GAS CHROMATOGRAPHIC INVESTIGATIONS OF AGGRESSIVE AND SENSITIVE SUBSTANCES. Rotzsche, H. (Institut fuer Silikon- und Fluorkarbonchemie, Radebeul, Ger.). Chimia (Aarau); Suppl.: 206-213(1970). (In German).

From 5th international symposium on separation methods: column chromatography; Lausanne, Switzerland (7 Oct 1969).

See CONF-691074-.

The gas chromatographic separation of aggressive and sensitive compounds requires suitable column materials, connecting tubes, detectors, and separation media. In a survey, these preconditions are discussed as well as the gas chromatographic study of halogens, inorganic and organic halides (including UF_6), metallo-organic compounds, hydrides, and chelates. Also discussed are several problems concerning the gas chromatographic analysis of fatty acids, amino acids, sugars, turpenes, and insecticides. (tr-auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 8190 and 8206.

7911 TRANSFORMATION OF AMINOETHYLISOURONIUM SALTS. I. S-aminoethylisothiouronium Bromide Hydrobromide-^{14}C. Kronrad, L.; Kozak, I. (Ceskoslovenska Akademie Ved, Prague). J. Label. Compounds; 9: No. 1, 107-116(1973).

S-aminoethylisothiouronium bromide hydrobromide-^{14}C (AET), a radioprotective substance, is transformed spontaneously in aqueous solutions, mainly to 2-aminothiazolines (2-AT), which is more toxic and less radioprotective. The mechanism of the transformation of AET has been studied by the aid of labelled AET-^{14}C. Paper chromatography has also shown other transformation products are formed. The R_F values of all substances resulting from the transformation of AET-^{14}C are given. It was found that the rate of transformation depends considerably on the temperature and that the transformation reaction is a mono-molecular one. The transformation rate of AET-^{14}C to 2-AT-^{14}C at temperatures close to 0°C is very low. Therefore older solutions of AET, if stored at these temperatures, may be used in experiments or in practice. (BE)

Isotope Effects

Refer also to abstract 8004.

7912 HEAVY ATOM KINETIC ISOTOPE EFFECTS. Pt.1 Liquid Phase Decarboxylation of Malonic Acid. Loudon, A. G.; Maccoll, A.; Smith, D. (Univ. Coll., London). J. Chem. Soc., Faraday Trans., I; 69: No. 5, 894-898(1973).

The $^{13}C/^{12}C$ isotope effects in the decomposition of all the mono-^{13}C malonic acid species were determined. Three rate constant ratios were determined, and two of these are in good agreement with the values recorded in the literature. The third has not previously been reported. The present results are consistent with a six-centered transition state for this reaction. (auth)

7913 ISOTOPE EXCHANGE STUDIES WITH DIETHYL ACETALS IN ETHANOL AND THEIR MECHANISTIC IMPLICATIONS TO PROTOLYTIC REACTIONS OF ACETALS AND VINYL ETHERS. Kankaanperae, A.; Salomaa, P.; Juhala, P.; Aaltonen, R.; Mattsen, M. (Univ. of Turku, Finland). J. Amer. Chem. Soc.; 95: No. 11, 3618-3624(30 May 1973).

Rates of transacetalization of diethyl acetals in ethanol and those of formation of vinyl ethers from acetals were measured using ^{14}C and tritium labeling. Combining the results with those obtained for the ethanolysis of vinyl ethers, complete free energy profiles could be depicted for the formation of vinyl ethers from acetals. These indicated that the relative free energy levels of the consecutive transition states depend greatly on the polarity of the aldehyde component. Mechanistic implications to the hydrolytic cleavage of acetals and vinyl ethers were discussed. (auth)

7914 PHOTOREDUCTION OF α-TRIFLUOROACETOPHENONE. Competitive Charge Transfer and Hydrogen Abstraction. Wagner, P. J.; Leavitt, R. A. (Michigan State Univ., East Lansing). J. Amer. Chem. Soc.; 95: No. 11, 3669-3677(30 May 1973).

A kinetic comparison of the photoreduction of acetophenone (AH_3) and α, α, α-trifluoroacetophenone (AF_3) indicates the following. Since the ability of benzene ($K_q = 7 \times 10^5\ M^{-1}\ sec^{-1}$) and alkylbenzenes to quench triplet AF_3 does not depend on their C–H bond strength but does depend on their ionization potential, it is concluded that they quench triplet AF_3 by a rapid charge-transfer process. A small polar solvent effect and the low slope of a log k_q vs. IP plot suggest only ~20% electron transfer in the triplet CT complex. If the aromatic has benzylic hydrogens, the CT complex can transfer a proton to the carbonyl oxygen to yield the radical intermediates normally found in photoreductions. Proton transfer and reverse charge transfer to regenerate ground-state reactants compete about equally in the CT complex formed from triplet AF_3-toluene. The reactivity of cyclohexane indicates that triplet AF_3 does abstract hydrogen atoms directly, and more rapidly than does triplet AH_3. Deuterium isotope effects indicate that triplet AF_3 reacts with cumene both by charge transfer and by direct hydrogen atom abstraction, with toluene almost exclusively by the former process. Thus, the overall effect of α-fluorine substitution on triplet acetophenone is to increase the rates of both hydrogen abstraction and charge transfer complexing. The latter is enhanced more, so that it becomes the predominant photoreduction mechanism for AF_3 and alkylbenzenes. These rate enhancements are particularly interesting because the phosphorescence of AF_3 indicates a π,π^* lowest triplet, with a n,π^* triplet so close that it must be significantly populated and thus reactive at room temperature. (auth)

7915 DEUTERIUM ISOTOPE EFFECT AND MIGRATORY APTITUDES IN THE CLEMMENSEN REDUCTION OF 1-INDANONES. Galton, S. A.; Abbas, R. (Columbia Univ., New York). J. Org. Chem.; 38: No. 11, 2008-2011(1 Jun 1973).

2-Phenyl-1-indanone-2-d was reduced to 2-phenylindan-1,1,2-d_3 and 2-phenylindene-3-d_1, while 2-phenyl-1-indanone under identical conditions gave 2-phenylindan and 2-phenylindene, both in the ratio of 3:1. Kinetic measurements were carried out by following the increase in optical density for the formation of olefins. K_H/K_D was found to be 1.53. Reduction of 2-methyl-2-phenyl-1-indanone gave 2-methyl-2-phenylindan and 2-methyl-3-phenylindene, showing that the phenyl group migrated preferentially. 2,3,3-Triphenyl-1-indanone under identical conditions gave 1,1,2-triphenylindan and 1,1,2-triphenylindene.. The formation of 3 and 6 shows that hydrogen migrates better than phenyl. The low isotope effect and the migratory aptitude of H > phenyl > methyl support the proposed mechanism. (auth)

7916 SEARCH FOR AN ISOTOPE EFFECT IN DIFFUSION OF ^{14}C-SUBSTITUTED BENZENES IN UNLABELED BENZENA AT 25°C. Allen, G. G.; Dunlop, Peter J. (Department of Physical and Inorganic Chemistry, University of Adelaide, Adelaide, South Australia 5001). Phys. Rev. Lett. 30: No. 8, 316-318 (19 Feb 1973).

Tracer-diffusion coefficients are presented for several ^{14}C-substituted benzenes of varying molecular weight diffusing in unlabeled benzene at 25°C. The data, which were obtained with one magnetically stirred diaphragm cell, are compared with data in the literature and indicate that a very slight isotope effect is present in this nonpolar liquid. (auth)

7917 SOLVENT ISOTOPE EFFECTS ON pK_a OF ANILINIUM IONS IN AQUEOUS SULFURIC ACID. Jensen, J. L.; Gardner, M. P. (California State Univ., Long Beach). J. Phys. Chem.; 77: No. 12, 1557-1562(7 Jun 1973).

Solvent isotope effects on K_a of a variety of anilinium ions are reported. As anilinium ion pK_a changes from 5 to −6.5, $K_a(H_2O)/K_a(D_2O)$ changes from 4.6 to 1.4. These isotope effects consist of primary, secondary, and solvation isotope effects. In buffer solutions of constant ionic strength, it appears that changes in secondary isotope effect predominate over changes in primary isotope effect with changing substituents on the aryl group of the aniline. The solvation isotope effect does not appear to be extractable from the secondary isotope effect, except perhaps in the case of 2,4-dinitroaniline. (auth)

7918 VIBRATIONAL SPECTRA, STRUCTURE, AND NATURE OF THE PHOSPHORUS: NITROGEN BOND IN N,P,P,P-TETRAMETHYLPHOSPHINE IMIDE AND N-METHYL-d_3-P,P,P-TRIMETHYLPHOSPHINE IMIDE. Bragin, J.; Chan, S.; Mazzola, E.; Goldwhite, H. (California State Univ., Los Angeles). J. Phys. Chem.; 77: No. 12, 1506-1512(7 Jun 1973).

The vibrational spectra of the compound N,P,P,P-tetramethylphosphine imide and its N-methyl-d_3 analog were found to be consistent only with a C_s structure the vibrational potential function of which exhibits large deviations from local C_{3v} symmetry at both phosphorus and nitrogen. All 48 vibrational fundamentals expected under C_s molecular point symmetry were assigned based on group frequencies, isotopic frequency shifts, and Raman depolarization measurements. The P:N torsional modes were assigned at 112 and 100 cm^{-1} in the light and heavy molecules, respectively, and threefold barriers of 2.06 and 2.42 kcal/mol, respectively, were calculated from these assignments. The unusually low barrier to rotation around the formally double P:N bond confirms the results of low-temperature PMR studies of phosphine imides which indicate that the barrier to internal rotation in these molecules is below values reported for PN bond internal rotation in aminophosphines. The infrared spectrum of $(CH_3)_3PNCH_3$ liquid at room temperature (4000−300 cm^{-1}) and solid at −175°C (4000−200 cm^{-1}) and the Raman spectra of the light and N-methyl-d_3 liquids are presented and these show no evidence of the existence of dimers in either the solid or liquid states. (auth)

7919 SOLVOLYSIS AND ALKALINE HYDROLYSIS OF 1,1,2-TRIPHENYL-2-BROMOETHANOL. Study of ^{14}C-1 and ^{14}C-2 Effects. Laureillard, J.; Laurent, A.; Laurent, E. (Lyon Univ., Villeurbanne, France). Bull. Soc. Chim. Fr.; No. 1, 232-242(Jan 1973). (In French).

The results of the isotopic ^{14}C effect in the solvolysis of 1,1,2-triphenyl-2-bromoethanol are explained in terms of the mechanisms determined from studies of the reaction in a solvent containing $H_2{}^{18}O$ and dioxane. Isotopic effects alone are insufficient to establish the solvolysis mechanism. They do, however, enable the structure of the transition state for the migration of a phenyl group to be determined in this particular case. (Fr)

7920 ACTION OF AG IONS ON 1,1,2-TRIPHENYL-2-BROMOETHANOL. Study of Isotopic ^{14}C-1 and ^{14}C-2 Effects. Laureillard, J.; Laurent, A.; Laurent, E. (Lyon Univ., Villeurbanne, France). Bull. Soc. Chim. Fr.; No. 1, 242-248(Jan 1973). (In French).

The participation of the phenyl radical in the argentic dehalogenation of 1,1,2-triphenyl-2-bromoethanol was established from studies of the kinetics and of the products formed in a solvent containing $H_2{}^{18}O$. Studies of isotopic ^{14}C effects confirmed that the transition state for the migration of the phenyl radical is different to that observed in solvolysis in spite of similarity between the mechanisms. (Fr)

7921 DEHYDRATION OF 3-PHENYL-3-METHYL-2-BUTANOL. Isotopic Effects of ^{14}C-2 and ^{14}C-3. Laureillard, J.; Laurent, A.; Laurent, E. (Lyon Univ., Villeurbanne, France). Bull. Soc. Chim. Fr.; No. 1, 249-253(Jan 1973). (In French).

The chemical kinetics of this dehydration reaction which takes place in a dioxane−water−$HClO_4$ medium and involves the participation of phenyl radical without the breaking of the C-phenyl bond in the transition state were studied. Comparisons with previous cases enabled the factors intervening in the structure of the transition state corresponding to the phenyl migration to be established. (Fr)

Isotope Exchange and Isotope Separation

Refer also to abstracts 7994 and 8163.

7922 (LA-tr-73-12) METHOD OF THE ISOTOPE SEPARATION. Guers, K. 17 Dec 1970. Translation of German Patent 2,150,232. 9p. Dep. NTIS $3.00.

A method has been proposed for the separation of ^{235}U and ^{238}U in which a molecular gas (UF_6) is subjected to isotope-specific excitation using a CO-laser. After chemical transmutation of the absorbing molecules, the reaction products are separated by fractional condensation. Addenda to the patent suggest use of CO_2, NO, or CN lasers and temperature requirements for the method. (JGB)

7923 INVERSE MASS DEPENDENCE IN LIQUID DIFFUSION OF HEAVY IONS. Miller, L. (National Chemical Research Lab., Pretoria). Nature (London); 243: No. 5401, 32(4 May 1973).

Following a discussion of attempts to find isotope effects in liquid diffusion, experimental confirmation is reported of an inverse mass dependence for the diffusion of uranyl ions in aqueous solution and in agar gel. A prismatic cascade, 60 cm. high and cross section 10 by 60 cm. at the top, and containing 59 barriers of nylon gauze, was filled with distilled water, and uranyl nitrate solution of density 1.194 was introduced at the top. A layer of glass powder on the top barrier prevented convection of this concentrated solution. After 21 days a sample was drawn from the bottom, showing a depletion of ^{235}U. Results are shown in tabular form. It was possible to improve the efficiency of the barriers by using cylinders of sintered polystyrene beads impregnated with agar gel, or solid ajar cylinders supported by stainless steel gauze. The diffusion proceeded in a radial direction towards a central channel. Among conclusions reached was that persistence and backscatter play an even more prominent role in the diffusion of heavy solutes in light solvents than was assumed by Hevesy and Paneth (Manual of Radioactivity p. 195 (1938)). This results in inverse mass dependence. (UK)

7924 CHEMISTRY IN SUPERACIDS. V. Evidence for the Protonation of Chlorine, Bromine, Carbon Dioxide, and Xenon in Fluoroantimonic Acid Solution. Olah, G. A.; Shen, J. (Case Western Reserve Univ., Cleveland). J. Amer. Chem. Soc.; 95: No. 11, 3582-3584(30 May 1973).

Chlorine, bromine, carbon dioxide and Xe were found to be protonated in $HF-SbF_5$ solution based on their ability to suppress the isotopic hydrogen−deuterium exchange process of molecular D_2 in the superacid system, as evidenced by the sharp decrease in the amount of HD formed. The suppression effect is discussed according to (1) relative basicities of competing weak bases, (2) ability to quench the intermediate isomeric $(H, D)_2^+$ ions, and (3) solubilities in superacids. Molecular oxygen, whose gaseous proton affinity is lower than that of H_2 (D_2), and molecular N_2, whose gaseous proton affinity is slightly higher than H_2 (D_2), were found to have no suppression effect in the same system. (auth)

7925 VALENCE-BOND STUDY OF THE (H_2, D_2) EXCHANGE REACTION MECHANISM. Freihaut, B.; Raff, L. M. (Quantum Theory Research Group, Department of Chemistry, Oklahoma State University, Stillwater, Oklahoma 74074). J. Chem. Phys. 58: No. 3, 1202-1204 (1 Feb 1973).

A minimal-basis VB formulation of the H_4 system together with the Mulliken approximation, is used to investigate the potential barrier in the (H_2, D_2) bimolecular exchange reaction for a "Y"−"T"−"Y" mechanism previously suggested by Gimarc. The result indicate that "T" conformation energies are 100–160 kcal/mole above that of (H_2+D_2) and that an exchange process occurring via such a mechanism would yield activation energies incompatible with present shock-tube data. (auth)

7926 INVESTIGATIONS INTO THE ISOTOPE SEPARATION BY MEANS OF A VIENNA FILTER. Gelfort, E. Heidelberg; Univ. Heidelberg (1972). 114p. (In German).

Thesis.

The particle pathways in the crossed magnetic and electric field of a Wien filter are generally calculated and from these values the focusing properties, the projection errors, and the separation efficiency are determined. The mass separation is treated for a broad multiple charged ion beam in the UNILAC injector. For this kind of team the Wien filter is modified to a so-called wide-beam separator by means of an inhomogeneous magnetic field, and its projecting properties and its separation efficiency are studied. Proposals are made for the dimensioning of the Wien filter (length = 160 cm, E(x) = 12 kV/cm, B(y) = 8 kG). For a beam of 3 cm width consisting of ^{161}Er, ^{168}Er, and ^{170}Er isotopes with an emissivity of 22.5 mrad × cm for the x,x'- and the y,y'-plane, respectively, a mass resolution of $M/\Delta M = 500$ is reached. (GE)

7927 ISOTOPE EXCHANGE OF CARBON MONOXIDE ON Fe_3O_4. Kasatkina, L. A.; Nekipelov, V. N.; Zhivotenko, N. N. (Moscow Chemical-Technical Inst.). Kinet. Katal.; 14: No. 2, 363-371(1973). (In Russian).

The isotope exchange reactions in CO molecules, between CO and CO_2, the oxidation of CO on Fe_3O_4, and the exchange of the

oxygen of Fe_3O_4 with CO and CO_2 were studied using the isotopes $^{12,13}C$ and $^{16,18}O$. For example, the reaction $^{12}C^{18}O + {}^{13}C^{16}O \rightleftharpoons {}^{12}C^{16}O + {}^{13}C^{18}O$ was examined at temperatures ranging from -78 to 400°C at a CO pressure of 20 torr, in the presence of Fe_3O_4 which had been preconditioned in a vacuum. As a second example, the reaction $C^{18}O + Fe_3{}^{16}O_4 \rightleftharpoons C^{16}O + Fe_3{}^{16}O_3{}^{18}O$ was investigated from 25 to 400°C at 20 torr pressure of CO. From a comparison of the several reaction rates, several forms of adsorbed CO (on a Fe_3O_4 surface) and several mechanisms were postulated. (KSW)

7928 ISOTOPE EXCHANGE IN A HETEROPHASIC REACTION. The Extraction of M^+ by an Acid HA. Fomin, V. V. Dokl. Akad. Nauk SSSR; 208: No. 1, 156-159(1 Jan 1973). (In Russian).

Rate constants of a chemical reaction that occurred during extraction were determined with the aid of isotopic exchange in an equilibrium system. The simplest case was the extraction of ions of a metal M^+ by an acid MA under conditions so that a slow reaction $M^+ + A^- \rightleftharpoons MA$ occurs, but the compound MA passes over very rapidly from the aqueous phase to the organic one. The theoretical equations developed showed that the determination of the rate constant of heterophase reactions using isotopic exchange in the kinetic region differs significantly from analogous determinations in a homogeneous system. (KSW)

Radiation Chemistry

Refer also to abstracts 7989, 8331, and 8795.

7929 (AD-751481) AGING AND DEGRADATION OF POLYOLEFINS. II. Gamma-Initiated Oxidations of Atactic Polypropylene. Report No. 11 (final), 1 May 1971-31 August 1972. Decker, C.; Mayo, F. R. (Stanford Research Inst., Menlo Park, Calif.). 31 Aug 1972. Contract DAHC04-72-C-0007. 46p. (AROD-8255-5-C). NTIS.

The study presents the rates and products of oxidation of amorphous polypropylene (PP) as initiated by the action of γ rays, for comparison with the di-t-butylperoxy oxalate (DBPO)-initiated oxidations of PP and with the γ-initiated oxidations of polyethylene and ethylene-propylene copolymers. (NTIS)

7930 (AD-751482) AGING AND DEGRADATION OF POLYOLEFINS. III. Polyethylene and Ethylene Propylene Copolymers. Report No. 10 (final), December 1970-31 August 1972. Decker, C.; Mayo, F. R.; Richardson, H. (Stanford Research Inst., Menlo Park, Calif.). 31 Aug 1972. Contract DAHC04-72-C-0007. 29p. (AROD-8255-7-C). NTIS.

Reported is a comparison of the effects of changes in structure and degree of crystallinity on oxidations of polyethylene (PE), ethylene-propylene copolymers (EP), and polypropylene (PP) at the same rates of γ-initiation at 45°C. (NTIS)

7931 (CONF-730514-1) STUDY OF GAMMA-INDUCED, LOW TEMPERATURE OXIDATION OF TEXTILE EFFLUENTS. Ketchen, E. E.; Case, F. N.; Alspaugh, T. A. (Oak Ridge National Lab., Tenn; Cone Mills Corp., Greensboro, N. C. (USA)). [nd]. 19p. Dep. NTIS $3.00.

From symposium on the textile industry and the environment; Washington, District of Columbia, USA (22 May 1973).

Gamma irradiation of textile dye effluents under oxygen pressures up to 1500 psi, with and without activated charcoal present, was studied as a method for removing color and removal of substances contributing to the chemical oxygen demand (COD). Both color and COD reduction are directly related to the radiation dose and pressure of the oxygen over the dye solution samples during irradiation. Color removal was achieved in solutions of dye prepared in the laboratory for process evaluation and for authentic textile mill waste effluents. The study revealed a new method for in-situ reactivation of charcoal by γ-radioinduced oxidation of organic compounds adsorbed on charcoal. This discovery permits a large reduction in the gamma source size required for processing textile mill effluents because the water fraction of the effluent does not need to be irradiated to the same degree as the organic material contained in the effluent. (auth)

7932 (GSF-BT-76) DEVELOPMENT OF AN X-RAY FLASH DEVICE FOR PULSE RADIOLYSIS. Hinsch, H. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Hanover (West Germany). Institut fuer Strahlenbotanik; Technische Universitaet, Hanover (West Germany)). Feb 1972. 131p. (In German). INIS.

Thesis.

An x-ray pulse lasting some 20 to 24 μsec and at a maximum 200 rad was created with an average quantum energy of 63 keV in an x-ray tube, in which the anode in the form of a tube was concentrically surrounded by the cathode. The physical details of the release of electrons at the cathode and the transport of charge between the electrodes are largely explained by means of theoretical considerations and measurements. Tests on the formation and decomposition of hydrated electrons and half-reduced eosine in water are described. The extinction charges reach 7% and agree sufficiently with the values calculated from the dosage used. (auth)

7933 (JAERI-5028) FUNDAMENTAL STUDIES IN OSAKA LABORATORY FOR RADIATION CHEMISTRY. Annual report, April 1, 1971 - March 31, 1972. (Japan Atomic Energy Research Inst., Osaka. Osaka Lab). 1973. 107p. (In Japanese and English). Dep. NTIS (U. S. Sales Only) $7.50.

Separate abstracts were prepared for eleven studies. The two remaining investigations dealt with reflectance of thin polystyrene film-aluminum system in vacuum ultraviolet region and the effect of graft copolymer on demixing of immiscible polymer solution and emulsion formation in a good solvent. (DHM)

For abstracts of individual papers see: 7934-7944.

7934 (JAERI-5028, pp 1-11) RADIATION-INDUCED POLYMERIZATION OF VINYL MONOMERS AT GAS/WATER INTERFACE. Hatada, M.; Nishii, M.; Hirota, K. 1973. (In Japanese).

Studies were carried out on the radiation-induced polymerization of vinyl monomers at gas/water interface using automatic surface balance techniques. The surface balance is a float type (Langmuir type), and the surface pressure was sensed by a linear variable differential transformer connected to a torsion wire and recorded on an xy recorder as a function of area or on a yt recorder as a function of irradiation time. Monolayers of monomers were irradiated with electron beams from a Van de Graaff electron accelerator either at nitrogen/water or at air/water interface, and the reaction was followed by measuring surface pressure-area isotherms on the xy recorder at intervals or by recording surface pressure change continuously during irradiation. Monolayers of octadecyl acrylate (ODA), octadecyl methacrylate (ODMA), and vinyl stearate (VST) gave surface pressure-area isotherms showing characteristic features for those of polymer monolayers when irradiated at nitrogen/water interface, while no indication of polymerization by irradiation was obtained for the monolayers when they were subjected to irradiation at air/water interface. (auth)

7935 (JAERI-5028, pp 12-19) γ-IRRADIATION EFFECTS ON MONOMER-CLAY COMPLEX. 1. Free Radical Formed in Methyl Methacrylate and Octadecyl Methacrylate-Montmorillonite Complexes. Sugimoto, S.; Ohnishi, S.; Nitta, I. 1973. (In Japanese).

γ-Irradiation effects on methyl methacrylate (MMA) and octadecyl methacrylate (ODMA) - montmorillonite complexes were studied comparatively with those on bulk monomers by ESR. The $(CH_3)_2$ CCOOR radical formed by the addition of a hydrogen to the double bond of a monomer was formed by irradiation at -196°C, but the line width of the monomer - clay complexes was narrower than that of bulk monomer. The radical pair in MMA and ODMA-clay complexes and the alkyl radical in ODMA - clay complexes were not detected. Decay behavior of the radicals in the monomer - clay complexes was different from the bulk monomers, and the radicals in the complexes decayed at lower temperatures than those in the bulk state. Broad line NMR measurements showed that radical decay was related to the mobility of absorbed monomer molecules on the montmorillonite complexes. (auth)

7936 (JAERI-5028, pp 20-29) ADSORPTION OF THE CATIONIC EMULSION PRODUCED BY RADIATION-INDUCED EMULSION POLYMERIZATION ONTO PAPER PULP. Inada, T.; Doi, Y.; Hayashi, K.; Kamiyama, H.; Okamura, S. 1973. (In Japanese).

Absorption of cationic emulsions onto pulp was studied by mixing positively charged polymer emulsions, containing a conventional emulsifier or a copolymerized cationic monomer, with wood pulps suspended in water. In order to obtain purely cationic emulsions without catalyser residue, all the emulsions were produced by γ-ray-induced emulsion polymerization. Test sheets of paper were prepared from these mixtures by the normal paper-making technique. Adsorption characteristics of the emulsions and tensile strengths of the treated papers were determined and compared with those of corresponding negatively charged polymer emulsion-pulp systems. The cationic emulsions were easily adsorbed by the pulp without employing a precipitating agent, and the emulsions with cationic emulsifier showed a larger amount of adsorption than those containing a copolymer of the cationic monomer. The adsorption was considered to be brought about by an electrostatic interaction with carboxyl groups in the pulp. Some cationic emulsions gave higher wet strength to papers than corresponding anionic ones. In addition to the above-mentioned ionic nature of the polymer emulsion, its charge site and minimum film

temperature seem to be also important factors governing the wet strength. (auth)

7937 (JAERI-5028, pp 30-34) EFFECT OF γ IRRADIATION ON MECHANICAL PROPERTIES OF NYLONS. Kaji, K.; Okada, T.; Sakurada, I. 1973. (In Japanese).

Changes in mechanical properties with γ-irradiation were studied of monofilaments of nylon 6, 610, and 12. Irradiation was performed at room temperature and 100°C either in air or in vacuo. As previously reported degradation predominated in all types of nylon when irradiation was carried out in air, whereas crosslinking took place predominantly in the case of irradiation in vacuo, irrespective of the irradiation temperature. Tensile strength and elongation measured at room temperature decreased monotonously with absorbed dose. Air-irradiation produced larger decreases in these properties than vacuum-irradiation. In vacuum the temperature of irradiation exerted a very small effect on these properties, whereas in air its effect was remarkable; their decreases were much larger in the irradiation at 100°C than at room temperature. No or very small increase in Young's modulus of nylons was observed with irradiation both in vacuo and in air. Resiliency of nylons also remained practically unchanged with irradiation. Little or no improvement of mechanical properties by crosslinking was observed even at an elevated temperature as 100°C. (auth)

7938 (JAERI-5028, pp 35-42) RADIATION-INDUCED GRAFT COPOLYMERIZATION TO POLYESTER. XI. Grafting of Acrylic Acid onto Polyethylene Terephthalate Fibers with Two-Step Impregnation Method. Okada, T.; Shimano, Y.; Sakurada, I. 1973. (In Japanese).

When polyester fiber was impregnated with pure acrylic acid (AA) or AA-water and irradiated with γ-rays from a ^{60}Co source or electron beams from a Van de Graaff accelerator at room temperature, almost all impregnated monomer was converted to unextractable PAA. However, the percent graft was too low since according to previous experiments ca. 15% graft was desirable to make polyester fiber hydrophilic. When pre-swelling with a suitable liquid was carried out and the impregnated liquid replaced with AA or AA-water, twice the amount of AA could be impregnated and converted to unextractable PAA by irradiation. Chlorinated hydrocarbons such as ethylene dichloride and 1,1,2,2-tetrachloroethylene were found to be more suitable as pre-swelling agent in the two-step impregnation than conventional swelling agents such as benzyl alcohol, dimethyl formamide, dimethyl sulfoxide, and nitrobenzene. When fibers with AA in addition to the impregnated AA were irradiated in the presence of Mohr's salt in the two-step method, higher than 20% grafting was easily realized at room temperature with high monomer utilization. (Auth)

7939 (JAERI-5028, pp 43-51) RADIATION-INDUCED GRAFT COPOLYMERIZATION TO POLYESTER. XII. Grafting of Acrylic Acid onto Polyester Fibers with One-Step Impregnation Method. Shimano, Y.; Okada, T.; Sakurada, I. 1973. (In Japanese).

Polyester fiber was impregnated with a mixture of acrylic acid (AA), water and ethylene dichloride and irradiated with electron beams from a Van de Graaff accelerator for graft polymerization. The mixture contained in most cases a small amount of Mohr's salt to prevent polymerization of AA outside of the fiber. About 15 to 20% apparent graft was easily obtained by irradiation of 2 to 4 Mrad electron beams at room temperature with monomer utilization greater than 80%. The graft fibers were dyed homogeneously by cationic dyes to a deep color. Cross-sections of dyed fibers showed that when the time of steeping of the fiber in the monomer mixture for impregnation is short, only the periphery of the fibers was grafted to show colored rings, whereas sufficiently long steeping resulted in homogeneous grafting throughout the cross-section. Trichloroethylene, 1,1,2-trichloroethane, and 1,1,2,2-tetrachloroethane can also be employed for the impregnation instead of ethylene dichloride, whereas dimethylformamide and nitrobenzene are unsuitable for the purpose though they are good swelling agent for polyester fibers. Ethylene dichloride and the other halogenated hydrocarbons do not only act as a swelling agent to increase the diffusion rate and amount of AA in polyester matrix but also accelerate the rate of polymerization presumably by free radicals formed by their radiation induced decomposition. It was experimentally confirmed that Mohr's salt inhibited homo-polymerization outside of the fiber only, it cannot enter into the fiber matrix, therefore, it can play no role in the graft copolymerization. (auth)

7940 (JAERI-5028, pp 52-60) RADIATION-INDUCED GRAFT COPOLYMERIZATION TO POLYESTER. XIII. Grafting of Methacrylic Acid onto Drawn Polyethylene Terephthalate Fibers with Immersion Method. Kaji, K.; Okada, T.; Sakurada, I. 1973. (In Japanese).

Radiation-induced grafting of methacrylic acid onto drawn polyester fibers was studied with an immersion method. Polyester fibers were immersed in the aqueous solution of methacrylic acid containing copper sulfate as a polymerization inhibitor and irradiated with γ-rays at a temperature between 19°C and 150°C. When copper sulfate was used for suppressing formation of methacrylic acid polymer in the liquid phase outside of fibers, the grafting reaction proceeded readily at a temperature near the glass transition temperature of polyester, i.e., ca. 75°C. Either below 50°C or above 120°C, practically no grafting reaction took place. For irradiation above 50°C no formation of methacrylic acid polymer in the liquid phase outside of fibers was observed when the copper salt was present. When a small amount of ethylene dichloride was added to the aqueous solution of methacrylic acid containing the copper sulfate, grafting took place even at room temperature. For the mixture of methacrylic acid-ethylene dichloride-water containing copper sulfate at a concentration of 5×10^{-2} mole/l, grafting proceeded readily at 40°C and a very small amount of poly(methacrylic acid) was formed in the liquid phase outside of fibers. For the grafting systems the rate of grafting steadily increased in the initial stage of the reaction. The autocatalytic effect was greater when the reaction system contained no ethylene dichloride. The activation energy was determined to be 22.6 kcal/mole between 50°C and 70°C, and 10.7 kcal/mole between 70°C and 86°C for the grafting in aqueous solution of methacrylic acid without ethylene dichloride, and 8.7 kcal/mole between 20°C and 50°C for the mixture of methacrylic acid–ethylene chloride–water. (auth)

7941 (JAERI-5028, pp 61-67) MODIFICATION OF PAPERS BY RADIATION-INDUCED POLYMERIZATION OF VINYL MONOMERS WITH ELECTRON BEAMS. Ohtsuki, H.; Okada, T. 1973. (In Japanese).

For the purpose of improving wet strength, kraft papers were impregnated with vinyl monomer such as methyl methacrylate, acrylonitrile, or styrene to 15 to 20% by weight of the paper, and subjected to electron beam irradiation from a Van de Graaff accelerator in nitrogen atmosphere at room temperature for polymerization. Methanol was added to the monomer to accelerate penetration and polymerization of the monomer in paper. Radiation polymerization took place also very readily in paper containing a small amount of water. The polymerization rate by irradiation decreased in the following order: methyl methacrylate > acrylonitrile > styrene. For irradiation dose of 2 Mrad, methyl methacrylate polymerized up to 95% conversion. More than 80% of the polymer formed in paper was non-extractable with acetone. Wet tensile and wet ring crush strength were measured for the papers after the polymerization treatment. Wet tensile or wet ring crush strength of about 10 kg are values sufficient for the usage of this kind of paper in a wet condition, these values were obtained with an addition of 33 g/m^2 in the case of methyl methacrylate and 18 g/m^2 in the case of acrylonitrile and styrene. However, folding endurance of paper decreased notably with increasing amount of polymer loading. To increase wet mechanical properties with a small loss of folding endurance, styrene or acrylonitrile are preferable to methyl methacrylate. (auth)

7942 (JAERI-5028, pp 87-89) ESR SPECTRUM OF COPPER(II)-PYRIDINE COMPLEX FORMED ON THE INTERLAMELLAR SURFACES OF MONTMORILLONITE. Nagai, S.; Ohnishi, S.; Nitta, I. 1973. (In Japanese).

ESR technique was used to study the adsorption of pyridine on the interlamellar surfaces of Cu(II) montmorillonite. The parameters obtained from the spectrum of the absorbed sample, $g_{||} = 2.26$, $g_{\perp} = 2.07$ and $A_{||} = 184$ gauss suggest the formation of a square-planar complex, Cu (pyridine)$_4^{2+}$. Angular variation was observed in the ESR spectrum due to the complex in the oriented films. ESR spectrum is presented of γ-ray induced radicals in pyridine-d_5–Cu(II) montmorillonite. (auth)

7943 (JAERI-5028, pp 93-95) SYNTHESIS OF POLYSTYRENE WITH ACYL CHLORIDE END GROUPS BY RADIATION POLYMERIZATION. Ikada, Y.; Kawahara, T. 1973. (In Japanese).

Styrene was polymerized in the presence of small amounts of acetyl chloride (AC) or trichloroacetyl chloride (TCAC) by γ radiation. The number-average molecular weight of polystyrene was measured by a vapor-pressure osmometer and the amount of acyl chloride groups at the polymer end was determined by titration. The polymerization rate suggested that the initiating species of polymerization were mostly solvent radicals and that the radical chain transfer to solvents occurred predominantly in the case of styrene-TCAC, but insignificantly in the styrene-AC system. The number of acyl chloride end groups per one polystyrene molecule was found to be in both cases approximately unity. The polymerization mechanism was briefly discussed on the basis of the experimental results. (auth)

7944 (JAERI-5028, pp 96-99) RADIATION-INDUCED COPOLYMERIZATION IN UREA ADDUCT COMPLEXES. Hayashi, K.; Hayashi, K. 1973. (In Japanese).

Binary copolymerizations were carried out in urea adduct complexes using five different monomers, acrolein (AL), acrylonitrile (AN), butadiene (B), ethyl acrylate (EA) and vinyl chloride (VC). The following polymers were obtained for eight systems in which polymerization took place at low temperatures (−46 to −78°C); (a) one type of homopolymer: AL−VC, (b) one type of copolymer with a small amount of the second component of comonomer: AL−B, AN−B and EA−B, (c) mixture of copolymers: AN−EA, probably, AL−AN, AL−EA and B−VC. Infrared absorption spectra of the copolymers showed that there exist different configurations which were never observed in polymers obtained by the adduct polymerization of a single component. (auth)

7945 (JAERI-M-5057) PILOT PLANT FOR RADIATION INDUCED, SOLID-STATE POLYMERIZATION OF TRIOXANE. Sakamoto, M.; Nishimura, K.; Ito, A.; Iwai, T.; Nakamura, G. (Japan Atomic Energy Research Inst., Tokyo). Dec 1972. 40p. (In Japanese). NTIS (U. S. Sales Only).

In order to design a pilot plant for radiation-induced, solid-state polymerization of trioxane and associated equipment to be in the Takasaki Radiation Chemistry Research Establishment, including the operating conditions, the following were studied by small scale experiment: monomer purification, monomer granulation, pre-irradiation polymerization, extraction of unreacted monomer, polymer drying, polymer crushing, and polymer stabilization. The results obtained are (1) the effects of impurities contained in trioxane on the yield and molecular weight of polymer, (2) method of trioxane purification to obtain the specified purity, (3) the condition for uniform irradiation, (4) the effects of pre-irradiation and other polymerization conditions on the yield and molecular weight of polymer, and (5) the acetylation of polymer to prepare the workable product. Specifications of the pilot plant derived from the above results are also given. (auth)

7946 (JAERI-M-5071) RADIATION-INDUCED EMULSION COPOLYMERIZATION OF TETRAFLUOROETHYLENE WITH PROPYLENE EMULSION COPOLYMERIZATION BY THE SHAKING AGITATION METHOD. Matsuda, O.; Ito, M.; Suzuki, N.; Okamoto, J.; Danno, A. (Japan Atomic Energy Research Inst., Tokyo). Dec 1972. 19p. (In Japanese). NTIS (U. S. Sales Only).

To produce the high molecular weight tetrafluoroethylene−propylene copolymer, radiation-induced emulsion copolymerization by shaking agitation was studied. Anionic fluoro-surfactant, ammonium perfluorooctanoate as the dispersing agent is suitable for the emulsion polymerization system. With the surfactant, the radiation-induced emulsion copolymerization proceeds under moderate conditions, i.e. room temperature and about 30 atm. The product is a colorless, transparent and amorphous alternative copolymer in the molecular weight range of 5×10^4 to 9.5×10^4. The rate of polymerization is proportional to the dose rate, but the molecular weight is not influenced by it. The results are not in accord with the Smith-Ewart theory that the main termination reaction is recombination of the propagating radicals. The emulsion polymerization proceeds by radical mechanism with the termination reaction of unimolecular process (degradative chain transfer). (auth)

7947 (LA-5186) TIME- AND SPACE-RESOLVED PHOTOCHROMISM OF HYDRATION ELECTRONS PRODUCED DURING NANOSECOND RADIATION PULSES. Berzins, G. J.; Han, K. S.; Noel, B. W. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 13p. Dep. NTIS $4.00.

Transient photochromism following the radiolysis of aqueous solutions is studied using existing instrumentation to provide a new technique for space- and/or time-resolved radiation dosimetry. The theory of photochromism due to hydration electrons is examined from microscopic and macroscopic viewpoints. Experimental data are presented. The results are discussed from the perspectives of applicability to radiation-pulse analysis and of correlation between theory and experiment. (auth)

7948 EFFECTS OF Co-60 GAMMA RADIATION ON THE THERMAL DECOMPOSITION OF CARBONATE COMPOUNDS. Meyer, W.; LaBelle, D. W.; Rassoul, S. A. (Kansas State Univ., Manhattan). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 315-318(Jun 1973).

Powdered zinc and manganous carbonates were isothermally decomposed to metallic oxides and carbon dioxide gas in an inert atmosphere of flowing helium at various temperatures between 180° and 350°C. The decompositions were studied by periodically measuring the carbon dioxide content of the helium flow with a gas chromatograph. Similar experiments were made on the carbonates after receiving ^{60}Co γ radiations. Definite effects of the pre-irradiation treatment on the decompositions were ascertained by comparison of the carbon dioxide production rates obtained with and without irradiation. (auth)

7949 RADICAL IN FERROELECTRIC DGN-CRYSTAL. Abe, R.; Kawamura, A. (Toyoda Physical and Chemical Research Inst., Nagoya, Japan). Toyoda Kenkyu Hokoku; No. 25, 1-4(Mar 1972). (In Japanese).

The ESR spectra of γ-irradiated DGN were measured at 77°K. The spectrum of strong intensity was identified due to the positional symmetry to that of the radical formed at the position of NO_3. When the crystal was heated gradually from 77°K to room temperature, the intensity of the strong lines decreased abruptly near −67°C, the ferroelectric transition temperature and was never recovered. The yellow color of γ-irradiated DGN also disappeared in the same temperature range. (auth)

7950 SEMIPERMEABLE MEMBRANES OBTAINED BY GRAFTING POLYTETRAFLUORETHYLENE FILMS. Manufacturing Process and Properties of These Films. 1. Anionic and Cationic Mono-grafted Membranes. Jendrychowska Bonamour, A. M. (Centre National de la Recherche Scientifique, Meudon−Bellevue, France). J. Chim. Phys.; 70: No. 1, 12-19(Jan 1973). (In French).

A direct radiochemical grafting method was used to fix hydrophylic polymeric branches (consisting of poly(acrylic acid) or poly(4-vinylpyridine)) onto polytetrafluorethylene films. Certain properties of the membranes obtained in this way were studied: their swelling, their chemical resistance, and their electrical conductivity. The swelling of carboxylic membranes in water depends on their chemical form (potassium acrylate or free acid) and their composition (number of grafted branches). In addition, the swelling is more enhanced the smaller the dose rate used in their preparation (long grafted chains). The porosity of the carboxylic membranes can be increased by submitting them to successive neutralization and acidification cycles. The results obtained are discussed. The quaternization of pyridinic membranes with acid increases their swelling in water. In contrast, sulfuric acid cross links the pyridinic branches with divalent SO_4−ions. This process results in a reduction in the swelling and in the conductivity of the membranes. (France)

7951 SEMIPERMEABLE MEMBRANES OBTAINED BY GRAFTING POLYTETRAFLUORETHYLENE FILMS. Manufacturing Process and Properties of These Films. 2. Anionic and Cationic Membranes. Jendrychowska−Bonamour, A. M. (Centre National de la Recherche Scientifique, Meudon Bellevue, France). J. Chim. Phys.; 70: No. 1, 20-26(Jan 1973). (In French).

Semipermeable membranes containing both carboxylic and basic groups were prepared by radiation chemical grafting of acrylic acid followed by 4-vinylpyridine onto polytetrafluoroethylene films. In order to prevent the spontaneous polymerization of the vinylpyridine in contact with the branches of free polyacrylic acid the acid was previously neutralized with potassium hydroxide. Studies of the second 4-vinylpyridine graft demonstrated a marked increase in the reaction rate brought about by the presence of carboxylic groups. The reaction kinetics are discussed, and in particular, the effect of the composition and structure of the carboxylic membranes on the grafting. The swelling in water of the membranes is very rapid. The degree of swelling of these membranes is dependent upon the number of grafted branches and the lengths of these branches. The degree of swelling varies considerably with the degree to which the membranes are neutralized. The degree of swelling is very much less in sulfuric acid than in hydrochloric acid. The electrical conductivity of the membranes varies linearly with the total amount of the grafting. In acid media, it increases linearly with the number of pyridinic branches; in basic media, it decreases with increased vinylpyridine grafting. (France)

7952 FREE RADICAL YIELDS IN THE RADIOLYSIS OF GASEOUS HEXAFLUORETHANE. Cooper, R.; Haysom, H. R. (Univ. of Melbourne, Parkville, Australia). J. Chem. Soc., Faraday Trans., I; 69: No. 5, 904-913(1973).

The radiolysis of gaseous hexafluoroethane yields CF_4(G = 2.5), C_3F_8(G = 0.31) and C_4F_{10}(G = 0.10) as major products. In the presence of Br_2, Cl_2, or HCl these products are scavenged and replaced by yields of CF_3 and C_2F_5 scavenged products. The yields of these scavenged products are independent of pressure above 5 mole% scavenger and are ~G = 2.6 for both CF_3 and C_2F_5 radicals. In the presence of chlorine and HCl, not all the CF_4 is scavengeable even though the CF_3 and C_2F_5 radical yields are independent of scavenger concentration. Statistical combination-cross combination ratios may be used to reconcile the observed radical yields with the yields of stable fluorocarbon products. Competition kinetics in the $Br_2 + Cl_2 + BrCl$ system indicate that some of the CF_3 scavenged products are due to either hot radicals or ions. (auth)

7953 KINETICS OF OZONE FORMATION IN THE PULSE RADIOLYSIS OF OXYGEN + ETHYLENE MIXTURES. Bevan, P. L. T.; Johnson, G. R. A. (Univ. of Newcastle upon Tyne, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 5, 922-927(1973).

Pulse radiolysis of $O_2 + C_2H_4$ mixtures was used to determine the rate constant of the reaction $O + O_2 + M \rightarrow O_3 + M$ ($M = C_2H_4$) the values, obtained from the kinetics of O_3 formation and from the dependence of the O_3 yield on C_2H_4 concentration, being $6.5 \pm 0.7 \times 10^{-32}$ and $5.3 \pm 0.5 \times 10^{-32}$ cm^6 $molecule^{-2}$ s^{-1}, respectively. Competition studies, in the absence and presence of SF_6, show that C_2H_4 depresses the primary yield of O atoms from pulse irradiated O_2, the maximum depression by C_2H_4 being the same as that by SF_6. (auth)

7954 ENDOR OF TRAPPED HYDROGEN ATOMS IN GAMMA-IRRADIATED GLASSY ACID MATRICES AND IN POLYCRYSTALLINE OXYANION MATRICES. Helbert, John; Kevan, Larry (Department of Chemistry, Wayne State University, Detroit, Michigan 48202). J. Chem. Phys. 58: No. 3, 1205-1212 (1 Feb 1973).

Trapped H atoms are produced in H_2SO_4/H_2O and H_3PO_4/H_2O glasses and in $KHSO_4/H_2O$ and KH_2PO_4/H_2O polycrystalline matrices by γ-irradiation at 77°K. High power proton ENDOR spectra of the H atoms have been obtained and analyzed. Prominent matrix ENDOR lines at the free proton frequency together with weak sidebands are observed. Two methods have been developed for increasing the resolution of weak sidebands due to isotropic hyperfine interaction. The two methods involve high irradiation dose and the addition of paramagnetic transition metal ions. The ENDOR line shapes are analyzed in terms of modulation of the electron–nuclear dipolar interaction by the relaxing electron. The isotropic hyperfine constant is about 0.75 G in all matrices and is assigned to the nearest neighbor matrix protons 1.8 Å distant. The center matrix ENDOR lines have been analyzed by computer simulation of the line shape to arrive at the spatial extent of the H atom wavefunction. In glassy matrices the wavefunction is nearly unperturbed from that of the free atom, while in polycrystalline matrices the extreme tail the wavefunction shows significant distortion. (auth)

7955 THE SIMPLE EXPONENTIAL DISTRIBUTION FOR INITIAL ELECTRON-POSITIVE ION SEPARATION DISTANCES AS SEEN IN THE γ RADIOLYSIS OF ALKANES. Abell, G. C.; Funabashi, K. (Department of Chemistry and the Radiation Laboratory, University of Notre Dame, Notre Dame,Indiana 46556). J. Chem. Phys. 58: No. 3, 1079-1085 (1 Feb 1973).

A numerical solution of the Smoluchowski equation for diffusion, reaction, and neutralization of ion pairs in a dielectric medium in the presence of a scavenger has been applied for analysis of recent electron scavenging experiments in alkanes. It is shown that these experiments can be quantitatively understood in terms of a simple exponential distribution of initial electron–positive ion separation distances. The credibility of this distribution is considerably enhanced when it is employed, in conjunction with Onsager's solution for diffusion of an ion pair in the presence of an external field, to calculate ion yields as a function of field strength. The agreement with experiment is once again excellent. (auth)

7956 CHEMICALLY INDUCED DYNAMIC ELECTRON POLARIZATION. II. A GENERAL THEORY FOR RADICALS PRODUCED BY PHOTOCHEMICAL REACTIONS OF EXCITED TRIPLET CARBONYL COMPOUNDS. Wong, S. K.; Hutchinson, D. A.; Wan, J. K. S. (Department of Chemistry, Queen's University, Kingston, Ontario, Canada). J. Chem. Phys. 58: No. 3, 985-989 (1 Feb 1973).

Electron spin resonance emission was observed from some photochemically produced semiquinone radicals in liquid isopropanol. It is proposed that the dynamic electron polarization is due to the optically spin polarized triplets of the parent quinones and their subsequent hydrogen abstraction reaction with retention of polarization in the resultant semiquinone radicals. Theoretical calculations have been carried out using typical zero field parameters for aromatic triplet molecules and the established assumption that the intersystem crossing rates to the three sublevels are unequal. Calculations reveal significant spin polarization of the triplets randomly oriented in an arbitrary magnetic field. Further treatment shows that when the triplet depolarization via relaxation is comparable to the chemical hydrogen abstraction rate, the resultant radical retains the polarization and is thus in the emissive mode. (auth)

7957 FORMATION SPECTRA AND SOME CHEMICAL PROPERTIES OF OXYDIODINE RADICALS IN AQUEOUS SOLUTIONS. Tendler, Y.; Faraggi, M. (Atomic Energy Commission, Nuclear Research Centre–Negev, P.O.B. 9001, Beer–Sheva, Israel). J. Chem. Phys. 58: No. 3, 848-853 (1 Feb 1973).

The reactions of the hydrated electrons (e^-_{aq}) and OH radicals (generated by the interaction of fast electrons with water) with IO^-_3 and IO^- have been investigated by the pulse radiolysis technique. Absorption spectra of the transient species produced in the range 250–800 nm, have been obtained. IO_2 formed by the reaction: $IO^-_3 + e^-_{aq} \rightarrow IO_2 + 2OH^-$, $k_1 = 7.7 \times 10^9 M^{-1}$ $Hsec^{-1}$ has a maximum absorption at 490 nm ($\epsilon_{490} = 1.5 \times 10^3 M^{-1}.cm^{-1}$). No evidence was found for an absorption band at $\lambda_{max} = 715$ nm as previously claimed for this species. The transient absorbing species at $\lambda_{max} = 360$ nm ($\epsilon_{360} = 8.0 \times 10^2 M^{-1}.cm^{-1}$) formed by the reaction of OH radicals and IO^-_3, is probably $(IO_3)^-_2$, e.g., $IO^-_3 + OH \rightarrow IO_3 + OH^-$, $k_2 = 1.7 \times 10^7 M^{-1}.sec^{-1}$; $IO_3 + IO^-_3 \rightleftharpoons (IO_3)^-_2$, $K_3 = 23 M^{-1}$. In $I^- + IO^-$ alkaline solutions two transient absorption bands at 370 and 700 nm are formed which decay at the identical rate ($8.1 \times 10^9 M^{-1}.sec^{-1}$). This and the fact that in I^- alkaline solutions the same spectrum was observed indicate that the band at 700 nm is also due to I^-_2. The decay kinetics of IO_2 radicals have been measured. It is a second order reaction: $IO_2 + IO_2 \rightarrow$ Prod, $2k_5 = 9.3 \times 10^9 M^{-1}.sec^{-1}$. The decay of $(IO_3)^-_2$ depends on IO^-_3 concentration. A mechanism for this reaction is proposed. (auth)

7958 ELECTRONIC SPECTRA OF ION RADICALS AND THEIR MOLECULAR ORBITAL INTERPRETATION. III. Aromatic Hydrocarbons. Shida, T.; Iwata, S. (Inst. of Physical and Chemical Research, Saitama, Japan). J. Amer. Chem. Soc.; 95: No. 11, 3473-3483(30 May 1973).

Utilizing the radiation-induced one-electron oxidation and reduction, a number of new ion radicals of aromatic hydrocarbons were produced and comprehensive data are analyzed in terms of SCF–MO calculations. Some spectral data in the literature are discussed critically. A relatively simple correlation of the transition among the ions of the same molecular symmetry is pointed out. A systematic difference between the cation and anion of alternant hydrocarbons was found and is suggested to be due to the involvement of a $\sigma-\pi$ interaction. With new spectra of cations and anions of some nonalternant hydrocarbons the failure of the pairing property is demonstrated. The cyclooctatetraene cation seems to undergo a peculiar photoinduced rearrangement reaction. (auth)

7959 ELECTRON SPIN RESONANCE SPECTRA OF γ-IRRADIATED OR PHOTOLYZED ARSINES. Lyons, A. R.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Amer. Chem. Soc.; 95: No. 11, 3483-3485(30 May 1973).

Exposure of trialkylphosphonium and trialkylarsonium ions in sulfuric acid glasses at 77°K to ^{60}Co γ-rays gave radicals whose ESR spectra are shown to be characteristic of the radical cations R_3P^+ and R_3As^+. The results confirm that these radicals are pyramidal with C_{3v} symmetry, the unpaired electron being in an orbital having a p:s ratio of about 8 which is strongly confined to the central atom. No proton hyperfine coupling was detected. These results are discussed in relation to a recent suggestion that R_3As^+ radicals have a very low spin density on As when R is aromatic. Results recently reported for R_2As radicals are largely confirmed, and attention is called to the remarkable similarity between the hyperfine tensor components for Me_2As and Ph_2As radicals. These results show conclusively that π delocalization of the unpaired electron into the aromatic rings in Ph_2As radicals is negligibly small. (auth)

7960 FORMATION OF H ADDUCT RADICALS IN CYTOSINE AND ITS DERIVATIVES. Westhof, E. (Univ., Regensburg, Ger.). Int. J. Radiat. Biol.; 23: No. 4, 389-400(Apr 1973).

Low-temperature irradiation and warming-up experiments were used to study by ESR the radical transformation in x-irradiated cytosine and its derivatives. It is shown that the H adduct radical of the base observed at room temperature is the result of the protonation of the base-anion radical observed at low temperature. In the nucleoside and nucleotide, this protonation occurs around 230°K. The main sources of protons are the molecules of crystallization and the sugar group. The different mechanisms proposed for the radiolysis of DNA constituents are discussed in connection with these findings. (auth)

7961 FURTHER NOTE ON THE RNHNH RADICAL IN X-IRRADIATED CYANOACETOHYDRAZIDE. Lin, W. C. (Department of Chemistry, University of British Columbia, Vancouver 8, B.C., Canada). J. Chem. Phys. 58: No. 6, 2664-2665 (15 Mar 1973).

It is postulated that when RNHNH is formed, the remaining proton of the NH_2 assumes a planar position and the unpaired electron occupies the $p\pi$ orbital of the nitrogen. This explains the main splitting in the ESR spectra being due to Nα and the attached H. It is postulated that extensive π delocalization exists in the cyanoacetohydrazide radical. This could be the reason for the dark color due to irradiation. The existence of the radical in enol form is discussed. (MCG)

7962 TIME RESOLVED ESR SPECTROSCOPY. I. A KINETIC TREATMENT OF SIGNAL ENHANCEMENTS. Fessenden, Richard W. (Radiation Research Laboratories, Center for Special Studies and Department of Chemistry, Mellon Institute of Science, Carnegie-Mellon

University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 58: No. 6, 2489-2500 (15 Mar 1973).

ESR experiments with time resolution on the order of 1 μsec have been carried out upon aqueous solutions during repetitive pulse radiolysis with a 2.8 MeV electron beam. The ESR spectrometer was operated with no field modulation, and spectra were presented as absorption curves. The radicals $\dot{C}H(CO_2^-)_2$, $\dot{C}H_2CO_2^-$, and hydroxycyclohexadienyl, formed in each case by reactions of OH, were studied and each spectrum showed evidence of nonequilibrium population of spin levels, with the low field lines of the latter two radicals observed in emission. For $\dot{C}H_2CO_2^-$ this emission persists for ≈50 μsec. The observed signals are described by enhancement factors V (fractional excess signal) of 0.23, 3.1, and 12.3, respectively. From the short spin relaxation times (1.4 μsec was measured for $\dot{C}H_2CO_2^-$) it is evident that emission existing at times much greater than this relaxation period must be the result of a continuous regeneration of the population differences by the radical–radical reactions. The form of the kinetic equations for the population of the spin levels is considered and an intrinsic enhancement factor defined ($Vt_{1/2}/T_1$) which takes into account the rate of radical reaction (through the initial second–order half–life $t_{1/2}$) and the spin relaxation times. This quantity is found to be fundamental to the radical system and is, within experimental error, the same for observations in both steady–state and pulse experiments where the radical lifetimes differ by a factor of ≈10. The equations developed successfully describe the time dependence of the observed ESR signals. The intrinsic enhancement factors are large (30–100) and represent ≈5%–10% adiabatic character of the recombination when so interpreted. The kinetic theory developed does not require that such large enhancements appear in the NMR spectra of the reaction products. (auth)

7963 TIME RESOLVED ESR SPECTROSCOPY, II. THE BEHAVIOR OF H ATOM SIGNALS. Verma, N. C.; Fessenden, Richard W. (Radiation Research Laboratories, Center for Special Studies and Department of Chemistry, Mellon Institute of Science, Carnegie–Mellon University, Pittsburgh, Pennsylvania 15213). J. Chem. Phys. 58: No. 6, 2501-2506 (15 Mar 1973).

The time dependence of the ESR signals of H atoms formed in acid water by pulse radiolysis has been examined at times >2 μsec after the pulse. As in steady–state experiments, the two lines are of very similar amplitudes but with the low–field line appearing in emission. A growth of signal is observed for the first 4–10 μsec depending upon the microwave power and dose per pulse. At the higher microwave powers (>1 mW) an oscillatory decay is observed which must be caused by the transient response of the spin system. An attempt has been made to explain the overall behavior of the ESR signals by introducing the assumption that the signal enhancement arises upon nuclear spin dependent recombination. This effect is included in the Bloch equations by a production term for M_z which is proportional to radical concentration (taken to decay by a second–order kinetic curve). The results of this calculation were very successful in fitting all details of the observed curves including the initial growth and the oscillatory behavior. An alternative assumption, that the signal enhancement occurred upon radical formation, did not lead to agreement with the observations. Because the initial growth is a direct consequence of the Bloch equations it is not necessary to invoke any chemical complications, such as a precursor of lifetime ≈5 μsec, to explain this phenomenon. The ESR signals of H atoms in acid were found to double upon addition of tert–butyl alcohol as an OH scavenger, and a much larger fractional increase was found in neutral, N_2O saturated water. These results are taken to show that the reaction H+OH is not selective as to the spin state of the H atom and so as a result produces no signal enhancement, while the reaction H+H and H+R do lead to signal enhancement. (auth)

7964 ON THE METASTABLE DISSOCIATION OF THE CH^+ ION PRODUCED BY ELECTRON IMPACT. Newton, Amos S.; Sciamanna, A. F. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). J. Chem. Phys. 58: No. 4, 1292-1299 (15 Feb 1973).

The metastable dissociation of CH^+ and CD^+ ions has been investigated. CH^+(m) from CH_4, C_2H_2, C_2H_4, $CHCl_3$, CH_2Cl_2, and CD^+(m) from CD_4, C_2D_2, C_2D_4, and CDF_3 were studied. CH^+(m) and CD^+(m) dissociate with an apparent half–life of $0.4\pm0.2\times10^{-6}$ sec and with kinetic energy release in the dissociation of 1.1 ± 0.3 and 1.4 ± 0.3 eV, respectively. Using 70 eV electrons, CD^+(m) and CH^+(m) are formed with initial kinetic energy, the value being dependent on the compound irradiated. Appearance potential measurements show that when formed from C_2H_2 and C_2D_2, the CH^+(m) and CD^+(m) must dissociate to the lowest dissociation limit of CH^+, i.e., C^+ ($^2P^0_{1/2}$) and H (^2S). It is postulated that the metastability arises from a predissociation of the b $^3\Sigma^-$ state with the repulsive c $^3\Sigma^+$ state of CH^+. (auth)

7965 PULSE RADIOLYSIS STUDY OF ARGON–NITROGEN MIXTURES. MEASUREMENT OF THE RATE CONSTANT OF METASTABLE ARGON DE–EXCITATION BY NITROGEN. Le Calvé, J.; Bourène, M. (C.E.N. Saclay, DRA/SRIRMa, B.P. n°2 91190, Gif s/Yvette, France). J. Chem. Phys. 58: No. 4, 1446-1451 (15 Feb 1973).

The postluminescence of $N_2(C^3\Pi_u \rightarrow B^3\Pi_g)$ induced by the transfer of energy to nitrogen by $^3P_2$ metastable argon atoms obtained by the pulsed radiolysis of argon–nitrogen mixtures has been studied spectrophotoelectrically. The emission decay lifetime τ is controlled by the destruction of metastable argon atoms. The variation of $1/\tau$ as a function of the argon or nitrogen pressure is used to determine the rate constants $k_{1(Ar+N2)}=3\pm0.3\times10^{-11}cm^3sec^{-1}$ and $k_{2(Ar+2Ar)}=6\pm0.4\times10^{-33}$ cm^6sec^{-1}. The general reaction process is discussed. The results obtained seem to show that the metastables are formed mainly from the dissociative recombination of Ar_2^+ ions. (auth)

7966 INHIBITED RADIATION GRAFTING IN THE POLYMERIZATION OF ACRYLONITRILE IN POLYETHYLENE FILMS. Kurilenko, A. I.; Yakimtsov, V. P. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk BSSR; 16: No. 10, 901-904(Oct 1972). (In Russian).

The effect of hydroquinone as an inhibitor on the graft polymerization of acrylonitrile in polyethylene films was studied. Experiments were conducted with 60-μ polyethylene films, irradiated by ^{60}Co γ rays at 300 R/sec, and acrylonitrile monomer. The dependence of the amount of grafted polyacrylonitrile in the polyethylene film on the radiation dose (from 0.1 MR to 2.5 MR) was evaluated. The relaxation modulus of the grafted polymer with and without inhibitor was measured. It was shown that the introduction of the inhibitor did not lower the effectiveness of the grafting process on the properties of the material, but suppressed homopolymer formation and helped to control the grafting process itself. (KSW)

7967 RADIOLYSIS OF AQUEOUS SOLUTIONS OF DNA AT 77 AND 195°K. Zakatova, N. V.; Sharpatyi, V. A. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 3, 688-689(Mar 1973). (In Russian).

Aqueous solutions of DNA (0.0033 M) were irradiated (radiation source not specified) at 77 and 195°C; at the higher temperature the yields of H_2O_2 and malondialdehyde were increased. Propyl gallate or myo(meso)inositol competed with DNA in the capture of OH· radicals; acceptor radicals OH· lowered the yields of H_2O_2 and malondialdehyde during irradiation of DNA at 195°C. (KSW)

7968 TEMPERATURE DEPENDENCE, OSCILLATOR STRENGTH, AND LINE SHAPE OF THE ALLOWED TRANSITION OF THE SOLVATED ELECTRON. Kestner, N. R. (Tel-Aviv Univ., Israel); Jortner, J.; Gaathon, A. Chem. Phys. Lett.; 19: No. 3, 328-331(1 Apr 1973).

Experimental data for the energy, the oscillator strength and the temperature dependence of the maximum of the allowed spectral transition of ammoniated and hydrated electrons are shown to be in good agreement with recent theoretical models. (auth)

7969 STRUCTURE DETERMINATIONS OF RADIATION CROSSLINKED POLYESTER RESINS. Schuh, H. Stuttgart; Univ. Stuttgart (1972). 81p. (In German).

Thesis.

In electron radiation hardening, the dependence of the weight yield of copolymeric hydrolysis products on the dose compared to the weight dependence of peroxide hardening (at usual peroxide concentrations), was studied. The crosslinking reaction by radiation hardening exhibits a greater azeotropy over the whole conversion than by peroxide hardening. The reaction phase in which it is most favorable to incorporate styrene due to the hindered segment diffusion of the segments of the polyester chains, is of less significance for radiation hardening than for peroxide hardening. This was confirmed by means of spectra and elementary analysis of the single fractions of the fractionation. Due to high radical concentration, the molecular weights of decomposition products in electron radiation hardening are significantly lower, the distribution of molecular weights is more uniform, a more uniform and more close-meshed network arises whose density is larger along the copolymeric chains than it is in peroxide hardening. (GE)

7970 MODEL FOR PRODUCTION OF HYDROGEN CLUSTERS. Prince, R. H. (York Univ., Toronto). Nature (London) Phys. Sci.; 242: No. 121, 127-128(23 Apr 1973).

Reference is made to Floyd and Prince (Nature Phys. Sci. 240: 11 (1972)) who reported the generation of water clusters of the type $H^+(H_2O)_n$ from the surface of ice films by low energy electron bombardment, and proposed a model utilizing the excess energy of the ionized fragment H^+. It is believed that the observed distribution of cluster size is determined by the lattice properties and not by a gas kinetic theory, based on the minimization of free energy; for the vacuum levels used in the experiments there is no mechanism whereby gaseous ion clusters may arrive at an equi-

librium size distribution. Water, however, is not an ideal molecule with which to establish these concepts; solid H_2 is more aminable, and the results of experiments by Clampitt and Gowland (Nature 223: 815 (1969)) are used as an additional test of the model, in which dissociative ionization of H_2 results in a family of the type $H^+(H_2)_n$. Reference is also made to Tantsyrev and Nikolaev (Doklady Akad. Nauk SSSR 206: 151 (1972)) who produced ion clusters of the type $H^+ (H_2O)_n$ by bombardment of ice films with 2-keV Ar ions, and who proposed a thermal sputtering mechanism, cluster growth occurring by the familiar gas phase ion-molecule reactions of the H_3O^+ solvation system. It is thought, however, that a microphysical model, as above proposed, is more appropriate. (UK)

7971 FORMATION OF EXCITED STATES IN THE RADIOLYSIS OF p-XYLENE. Gangwer, T.; Thomas, J. K. (Univ. of Notre Dame, IN). Radiat. Res.; 54: No. 2, 191-206(May 1973).

The pulse radiolysis technique was used to measure the yields of excited singlet and triplet states in benzene and p-xylene. In pure p-xylene transitory absorption spectra can be observed which are associated with the excimer, the triplet state, and a biradical. Similar data were obtained in benzene. By energy transfer to suitable polycyclic aromatic compounds it is found that G(singlet) = 1.70 in benzene, G(singlet) = 2.05, and G(triplet) = 2.35 in p-xylene. Unlike the benzene triplet in which the half-life is 3.5 nsec, the p-xylene triplet has a half-life of 28 nsec. The yields and data in benzene and p-xylene are discussed in terms of conventional radiolytic mechanisms in aromatic compounds, in which the triplet states may be formed directly or by ion neutralization. (auth)

7972 PHENYLATION OF NITROBENZENE BY γ RADIATION. Knight, J. A. (Georgia Inst. of Tech., Atlanta). Radiat. Res.; 54: No. 2, 207-211(May 1973).

Phenylation takes place during γ-radiolysis of pure nitrobenzene to produce the three isomeric nitrobiphenyls with ortho-para substitution favored over meta. This is in agreement with free radical phenylation. The effects of the diphenylpicrylhydrazyl (DPPH), galvinoxyl, and sulfur hexafluoride on the yields of the isomeric nitrobiphenyls were determined. The results with DPPH indicate that approximately 40% of the overall phenylation process is related to free radicals and excited molecules and, with SF_6, that approximately 33% is related to the anion, $C_6H_5NO_2^-$. The results with galvinoxyl are complicated by the fact that G for 2-nitrobiphenyl increases from 0.076 for pure nitrobenzene to 0.10 with galvinoxyl. This suggests that the galvinoxyl anion reacts with the solvent molecules to produce a phenylating species which exhibits greater ortho selectivity than the radiolytic phenylating species. (auth)

7973 CRYSTAL STRUCTURE AND RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF 1,3,5,7,9,11-HEXOXECANE. Chatani, Y. (Osaka Univ.); Ohno, T.; Yamauchi, T.; Miyake, Y. J. Polym. Sci., Polym. Phys. Ed.; 11: No. 2, 369-388(Feb 1973).

One of the cyclic oligomers of formaldehyde, 1,3,5,7,9,11-hexoxecane, was found to undergo polymerization in the solid state to form polyoxymethylene both during and subsequent to x- or γ-irradiation. The polymer yield increases with polymerization temperature but decreases drastically near the melting point of the hexoxecane crystal. In order to clarify the specificity of the solid-state polymerization, the crystal structure of hexoxecane was first analyzed; hexoxecane forms a trigonal crystal with cell dimensions of $a = b = 7.917$ Å, $c = 11.345$ Å, space group $R\bar{3} - C_{3i}^2$, three molecules of $\bar{3}$ symmetry per unit cell. The polyoxymethylene as polymerized from a single crystal of hexoxecane is highly crystalline and the crystallites are definitely oriented with respect to the original crystal. There are three kinds of oriented trigonal polyoxymethylene: i.e., with the polymer chains oriented along the ⟨100⟩, ⟨001⟩, and ⟨210⟩ axes of the hexoxecane crystal. The relative yields of these crystallites depend upon the polymerization temperature. In addition to the ordinary trigonal polyoxymethylene, oriented orthorhombic polyoxymethylene was also found in the case of polymerization during treatment with x-rays. (auth)

7974 ANALYSIS OF TEMPERATURE DEPENDENCE OF ELECTRON SPIN RESONANCE SPECTRUM OF $-OOCCF_2CFCOO-$ USING DENSITY MATRIX TECHNIQUES. Bogan, C. M.; Kispert, L. D. (Univ. of Alabama, Tuscaloosa). J. Phys. Chem.; 77: No. 12, 1491-1496(7 Jun 1973).

The temperature dependence of the α and β fluorines splittings in $-OOCCF_2CFCOO-$ (from irradiated single crystals of sodium perfluorosuccinate) was examined using density matrix techniques. The temperature dependence of the α-fluorine hyperfine splittings arises from a torsional oscillatory motion of the α fluorine about the $C_\alpha - C_\beta$ bond which averages the two crystallographically nonequivalent radicals observed at 77°K into a single radical at 300°K. The temperature dependence of the β-fluorine hyperfine tensors results from a nonadiabatic spin exchange, $\tau^{-1} = 9.9 \times 10^{12}$ exp $(-3680$ cal/RT) rad sec^{-1}, occurring as a direct consequence of the α-fluorine torsional oscillation coupled with a shift in the β-fluorine position. (auth)

7975 RADIATION-CHEMICAL AND PHOTOCHEMICAL DECHLORINATION OF POLYCHLOROBIPHENYL. Arai, S.; Matsui, M.; Moriguchi, J.; Imamura, M. (Inst. of Physical and Chemical Research, Wako, Japan). Rikagaku Kenkyusho Hokoku; 48: No. 6, 185-191(Nov 1972). (In Japanese).

Studies have been made on the radiation-chemical and photochemical dechlorination of polychlorobiphenyl (PCB) using kanechlor 400. It was found that the dechlorination proceeds most efficiently in both cases by chain mechanisms in deaerated 2-propanol-alcoholate solutions at room temperature. Irradiation was carried out by using $^{60}Co-\gamma$ rays and a low-pressure mercury arc. PCB and dechlorinated compounds were analyzed chromatographically and the liberated chloride ions were determined by titration. The dechlorination reactions in both the radiation-chemical and photochemical systems were found to be inhibited or retarded in the presence of oxygen, water, and the reaction products, acetone and biphenyl. From these experimental results it was concluded that the chain mechanisms occurring in both systems are presumably the same except for initiation processes. Some problems for industrial applications were also discussed briefly. (auth)

7976 EFFECTS OF ^{60}Co GAMMA IRRADIATION ON ELECTRODE REACTIONS OF ALUMINUM IN WATER. Lee, J. T.; Furukawa, K.; Ohno, S. I. (Japan Atomic Energy Research Inst., Tokai). Nippon Kagaku Kaishi; 1973: No. 1, 39-44(Jan 1973). (In Japanese).

The effects of $^{60}Co-\gamma$ irradiation on the electrode reactions of aluminum metal in water were investigated. Irradiation (up to 2.4×10^5 R/hr) caused a shift of the Al-electrode potential by several hundred millivolts to a more negative value. The irradiation also increased the anodic polarization current and decreased the cathodic polarization current. The results can be explained qualitatively in terms of radiation-produced electron-hole pairs in a barrier layer of an aluminum surface. (auth)

7977 UNSTABLE INTERMEDIATES. Pt. 126. Electron Spin Resonance Studies of the Effect of High Energy Radiation on Amines and Their Solutions in Water and Sulphuric Acid. Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Perkin Trans., II; No. 6, 797-803(1973).

Exposure of a range of amines and their solutions in water or sulphuric acid to ^{60}Co γ-rays gave, either directly or after annealing, radicals whose ESR spectra were characteristic of $R_2\dot{N}$, $R_2\dot{C}NR_2^+$, $R_3\dot{N}^+$, or $R_2\dot{C}-CH_2\dot{N}R_3$ radicals. The sequence of reactions leading to the formation of these radicals is discussed, together with various structural aspects. In addition to $H_2\dot{C}NH_2^+$ radicals, a species was detected in irradiated solutions of methylamine in sulphuric acid that is tentatively identified as a methyl radical weakly bonded to an ammonia molecule ($H_3\dot{C}$..... NH_3). (auth)

7978 ESR STUDY OF γ-IRRADIATED (AT 77°K) POLYCRYSTALLINE MANNOSES IN THE 77 TO 350°K RANGE. Nikitin, I. V.; Miroshnichenko, I. V.; Kudryashov, L. I.; Dyatkina, M. E.; Kochetkov, N. K. (Inst. of General and Inorganic Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 206: No. 4, 880-882(1 Oct 1972). (In Russian).

Radical products formed in γ-irradiated polycrystalline monosaccharides were investigated by ESR over the temperature range 77 to 350°K. Doses of 5 MR were administered at 77°K to samples of β-L-arabinose, α-D-xylose, β-D-ribose, α-D-galactose, α-D-glucose, and β-D-mannose. Simultaneously with the destruction of primary radicals, there was observed the appearance of new radicals that were stable at room temperature and that had characteristic singlets, doublets, triplets, and triplet-quadruplets. The stereochemistry of the processes is discussed. (KSW)

7979 EFFECT OF MATERIAL DISPERSION ON THE STABILIZATION OF CHARGES IN LOW-TEMPERATURE RADIOLYSIS. Aulov, V. A.; Sukhov, F. F.; Slovokhotova, N. A. (Physical Chemical Inst., Moscow). Dokl. Akad. Nauk SSSR; 206: No. 4, 899-900(1 Oct 1972). (In Russian).

The radiothermoluminescence of linear polyethylene, low density polyethylene, and the saturated hydrocarbon $C_{32}H_{66}$ was studied over the temperature range 100 to 270°K. At least two peaks were observed for all samples except one: a low-density polyethylene film had been reduced in particle size in liquid nitrogen to less than 5 μ and then warmed to room temperature before irradiation. This thermal history eliminated the second thermoluminescent peak (at ~240°C), and this phenomenon is interpreted in terms of charge stabilization theory. (KSW)

7980 ESR SPECTRA OF γ-IRRADIATED CRYSTAL HYDRATES OF BERYLLIUM, ZINC, AND CALCIUM SULFATES.

Karaseva, L. G.; Gromov, V. V.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 1, 131-134(1 Jan 1973). (In Russian).

Samples of $BeSO_4 \cdot 4H_2O$, $BeSO_4 \cdot 2H_2O$, $BeSO_4$, $ZnSO_4 \cdot 6H_2O$, $ZnSO_4 \cdot H_2O$, and $CaSO_4 \cdot 2H_2O$ were irradiated with ^{60}Co γ rays at $-196°C$ and at room temperature. Differences and analogies in the EPR spectra of the irradiated substances attributable to products of radiolysis are discussed. (KSW)

7981 ELECTRON-ELECTRON DOUBLE RESONANCE OF IRRADIATED MONOFLUOROACETAMIDE SINGLE CRYSTALS. The Role of Fluorine p-Orbital Anisotropy. Kispert, L.; Chang, K. (Univ. of Alabama, Tuscaloosa). J. Magn. Resonance; 10: No. 2, 162-169(May 1973).

From Southeastern Magnetic Resonance Conference; Georgia (Oct 1972).

Electron-electron double resonance (ELDOR) investigations of the $\cdot CFHCONH_2$ radical in irradiated fluoroacetamide crystals revealed a large intensity variation of the allowed-allowed and allowed-forbidden ELDOR lines which is dependent on the magnitude of the fluorine hyperfine anisotropy. At fluorine splittings of 300 MHz or larger, no ELDOR lines are observed at A_H; however, forbidden lines are observed at $(A_H/2) \pm \nu_H$. When the fluorine splittings are decreased below 250 MHz, ELDOR lines at A_H are observed with R equal to 2 to 5%. Intramolecular motion such as the torsional oscillations present about the C–C bond in $\cdot CF_2CONH_2$ appeared to be dominant over the fluorine p-orbital anisotropy as the primary mode of relaxation. The p-orbital anisotropy was also shown to be dominated by quadrupole relaxation from ELDOR measurements of $\cdot CClFCONH_2$. Only a small temperature dependence was found for ELDOR spectra of $\cdot CFHCONH_2$. (auth)

7982 EXCITATION OF ELECTRONS TRAPPED IN GLASSY ETHYLENE GLYCOL + WATER MIXTURES. Moan, J. (Norsk Hydros Institutt for Kreftforskning, Oslo). Int. J. Radiat. Phys. Chem.; 5: No. 3, (May 1973).

The mechanisms of excitation of electrons trapped in glassy ethylene glycol + water (1 : 1) were studied by thermoluminescence and ESR experiments. A steep increase of the quantum efficiency of photobleaching is observed above 2.3 eV, corresponding to a strong decrease in the intensity of thermoluminescence; this is attributed to photo-induced recombination of electrons with positive ions. The fact that excitation of the electrons with an energy of 2.1 eV or less cannot transfer the electrons to new traps shows that their lowest excited states are bound ones. From the ESR spectra of samples containing small amounts of an electron scavenger, it is concluded that the reaction paths of excited trapped electrons depend strongly on the excitation energy: at low excitation energies reaction with this solvent dominates; at higher excitation energies reaction with other radicals, scavenger molecules or retrapping in new traps become important. The effects of bleaching on the thermoluminescence glow curve suggest that the positive ions modify the trapping condition for electrons trapped in their vicinity and reduce the trap depth. (auth)

7983 EFFECT OF TRAPPED CHARGES ON THE HYDROGEN PEROXIDE FORMATION AT γ-IRRADIATED SILICA GEL SURFACES. Rabe, J. G. (Institut fuer Kernforschung, Berlin). Int. J. Radiat. Phys. Chem.; 5: No. 3, 301-308(May 1973).

Hydrogen peroxide and molecular hydrogen are formed when γ-irradiated silica gel is suspended in acidified water. Oxygen adsorbed on the gel prior to irradiation or subsequently increases the yield of hydrogen peroxide. A further accumulation is observed in suspensions containing alcohol or formic acid. Adsorption of hydrogen decreases the peroxide yield both with and without subsequent adsorption of oxygen but has no influence on the yield if adsorbed in a mixture with oxygen. The results are discussed in terms of the reactions of electrons and holes trapped at the surface of silica gel in the course of irradiation. (auth)

7984 FAST INFRA-RED DETECTORS FOR USE IN PULSE RADIOLYSIS. Seddon, W. A.; Selkirk, E. B.; Fletcher, J. W. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Int. J. Radiat. Phys. Chem.; 5: No. 3, 323-328(May 1973).

The characteristics are summarized of a number of fast response (<1 μs), solid state infrared detectors now being used for pulse radiolysis studies. Two in particular have proved very satisfactory. These are a silicon photodiode SGD-100A, Edgerton, Germeshausen & Grier Inc., covering the wavelength region 350 to 1100 nm, and a liquid nitrogen cooled indium antimonide detector, SD-8721-2, Spectronics, Inc., which has a nominal range of 1000 to 5500 nm. The former has a response time (0 to 98 per cent) $\leq$25 ns and the latter (0 to 100 per cent) $\leq$ 200 ns. (auth)

7985 RADIOLYSIS OF BINARY ETHANOL-WATER MIXTURES. Roux, J. C. (CEN, Gradignan, France); Baquey, C.; Sutton, J. Int. J. Radiat. Phys. Chem.; 5: No. 3, 309-322(May 1973).

Hydrogen, nitrite, acetyldehyde, 2,3-butanediol, and hydrocarbon yields produced by the γ-radiolysis of lithium nitrate in binary ethanol–water mixtures containing respectively, 5, 10, and 15 moles dm^{-3} of alcohol were determined. The "free-ion" solvated electron yields support the low value of $G_{e_s^-}$ (0.9 to 1.2) for pure ethanol. The results also show that the "molecular" acetaldehyde yield is not formed by the dismutation of hydroxyethyl radicals. (auth)

Radiochemistry and Nuclear Chemistry

Hot-Atom Chemistry

7986 (FRNC-TH-305) STUDY OF THE CHEMICAL EFFECTS OF NEUTRON CAPTURE BY PARADIBROMOBENZENE. Maes, D. (Paris Univ. (France)). 1971. 148p. (In French). NTIS (U. S. Sales Only).

Thesis.

Tubes containing paradibromobenzene cooled to liquid nitrogen temperatures were irradiated with thermal neutron flux. The paradibromobenzene was dissolved in Br_2-saturated CCl_4. Two methods were used to determine the retention dissolution and successive extraction using sodium sulfite; simultaneous dissolution and extraction using a CCl_4 + Br_2 + sodium sulfite mixture. The products formed were analyzed using gaseous phase chromatography. After extraction, the organic phase was hydrolyzed. The results obtained on the irradiation of paradibromobenzene in air or He enabled the chemical effects of the (n,γ) reaction on paradibromobenzene, the reactions subsequent to low temperature annealing (between –196 and 20°C) and the reactions subsequent to the high temperature annealing (between +20 and 80°C) to be studied. Isotherms and isochrones were obtained for the annealing in He and air. The dissolving of paradibromobenzene in α, β dibromoethane at –18, 0, and 20°C was also studied. In this way the behavior of the hydrolyzable polymer was studied. The existence of a labeled intermediate (precursor) trapped in the crystal lattice was established, the lifetime of which depends upon the dissolution conditions and the solvents used. (FR)

7987 (FRNC-TH-306) CHEMICAL CONSEQUENCES OF NEUTRON CAPTURE IN ORGANIC HALIDES. Effects of the Aggregation State. Mauguin, M. (Paris Univ. (France)). 1971. 123p. (In French). NTIS (U. S. Sales Only).

Thesis.

The chemical effects resulting from the $^{80m}Br \rightarrow {}^{80}Br$ isomeric transition taking place in solid binary mixtures of 1,1- and 1,2-$C_2H_4Br_2$ + $^{80m}Br_2$, CH_2Br_2 + $^{80m}Br_2$, and C_6H_6 + $^{80m}Br_2$ were investigated. The experiments were conducted at 77°K, (solid phase). A correspondence was established between the organic yields and the phase diagrams. The chemical consequences of the isomeric transitions taking place are related to the lack of homogeneity (of the nuclear recoil scale) in the binary mixtures. The chemical consequences of neutron capture in 1,1-$C_2H_4Br_2$ were then considered (phase and scavenging effects). The nuclear activation effect was defined in terms of the ratio between the ^{80m}Br and the ^{82}Br yields, the ^{80m}Br arising from (n,γ) reactions with ^{79}Br and ^{82}Br from the de-excitation of the ^{82m}Br state. The irradiations were effected at 273°K (liquid phase) and 77°K (solid phase). It was observed that when the nuclear activation effect coefficient exceeds unity the breakdown of the C–C and C–Br bonds is favorized. When these results are compared to those established from radiolysis and photolysis studies of dibromoethane, it is seen that a satisfactory explanation is possible in terms of a radiolysis effect following the emission of Auger electrons and an effect involving the kinetic energy of the radioactive recoiling atoms. (FR)

7988 REACTIONS OF ENERGETIC HYDROGEN ATOMS WITH SIMPLE HYDROCARBONS. Pt. 1. The Effect of Moderators. Baker, R. T. K. (United Kingdom Atomic Energy Authority, Harwell, Eng.); Malcolme-Lawes, D. J. J. Chem. Soc., Faraday Trans., I; 69: No. 5, 928-935(1973).

The reactions of recoil tritium atoms with ethane were studied in the presence of N_2 and CF_4 moderators. The results suggest that collisional dissociation of excited HT, initially produced by direct reaction, may be more important in determining the ratio of final products than the commonly described effect of energy shadowing. It is suggested that hydrocarbons behave essentially as carbon atoms as far as their ability to collisionally dissociate HT is concerned, and that moderators which consist of groups which are similar in mass to carbon atoms, exert very little effect on observed product ratios. (auth)

7989 IMPLICATIONS OF ION-MOLECULE REACTIONS OBSERVED IN SILANE FOR RECOIL SILICON ATOM STUDIES. Stewart, G. W.; Gaspar, P. P. (Central Research Department, Monsanto Company, St. Louis, Missouri 63166); Henis, J. M. S. J. Chem. Phys. 58: No. 3, 890-895 (1 Feb 1973).

Ion-molecule reaction sequences in silane, producing tertiary product ions, are reported. A mechanism is presented by which trisilane can be produced from Si^+ ions in recoil silicon studies. It is also reported that Si^+ ions can be efficiently neutralized by charge exchange with triethylamine. Preliminary studies indicate that the addition of triethylamine to recoil silicon experiments results in a decrease in the absolute yield of trisilane without affecting the yields of other products. In addition, information obtained from ion-molecule studies in silane is applied to radiolysis studies of silane. A mechanism is presented by which higher homologues are produced by hydride ion transfer. (auth)

Properties of Radioactive Materials

Refer also to abstracts 7893, 7923, 8164, 8169, 8174, and 9203.

7990 (IEA-278) REVERSE PRECIPITATION OF AMMONIUM DIURANATE FROM A SOLUTION OF URANYL SULFATE: DECONTAMINATION OF THE SULFATE ION. Abrao, A.; de Araujo, J. A.; Franca, J. M. Jr. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov 1972. 14p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $3.00.

A technique is described for the production of nuclear grade ammonium diuranate (ADU) using uranyl sulfate solutions obtained as eluate from the ion exchange (strong cationic resin) purification of uranium, by precipitation with NH_3 gas. The precipitation of ADU by direct introduction of NH_3 gas into acid uranyl sulfate solution has as a consequence a high coprecipitation of sulfate ion, reaching ratios as high as 10 to 14% SO_4/ADU. To overcome this serious inconvenience the reverse order of addition of reagents was studied, the ADU precipitation being done in such a way that the pH of the mixture was kept higher than 6 during the whole precipitation. This modification, in conjunction with the adjustment of other precipitation parameters, like temperature, precipitation time, aging time, concentration of uranium in uranyl sulfate, and pH, allowed a successful precipitation of ADU with low sulfate content. The technique was applied at pilot plant scale, using batch and continuous precipitation, in both cases the obtained ADU was low in sulfate. (auth)

7991 (RLO-2221-T-6-15) SPECTROSCOPIC STUDIES OF ACTINIDE IONS IN CRYSTALLINE SOLIDS. Progress Report, October 1, 1972–September 30, 1973. Gruber, J. B. (Washington State Univ., Pullman). 1973. Contract AT(45-1)-2221. 359p. Dep. NTIS $20.00.

Research is reported on magnetic resonance studies, optical absorption, fluorescence, and Zeeman studies, and electrical and thermal transport studies of actinide and rare earth ions in solids. A paper is included on interpretation of the vapor spectrum of UCl_4 that will be published in J. Chem. Phys. August 1, 1973. (DHM)

7992 IDENTIFICATION OF LABELLED STRUCTURES ON AUTORADIOGRAPHS. England, J. M.; Rogers, A. W.; Miller, R. G. (Northwick Park Hospital, Harrow, Eng.). Nature (London); 242: No. 5400, 612-613(27 Apr 1973).

It is stated that there is no agreed method of deciding whether or not a given structure is radioactive from its autoradiograph. Some investigators require that a cell, for instance, should have five or more overlying grains to be considered labelled, whereas others are satisfied with three or four grains. By setting such arbitrary limits the experimenter risks accepting as labelled some non-radioactive cells that, by chance, have a higher number of background grains over them, and risks rejecting as unlabelled radioactive cells that have failed to give rise to the requisite number of overlying grains. Various solutions to this problem have been proposed. An analytical method is here described that is simple and direct to use, and is accurate even when some of the radioactive cells have no overlying grains. Some experimental work is described, in which rat thoracic duct lymphocytes were incubated with ^{125}I-labelled normal rabbit globulin. Scintillation counting revealed that, on average, each lymphocyte was producing one disintegration every four days. The experiment was designed to show if all the lymphocytes in the sample were equally radioactive, or if a sub-group possessed the ability to bind immunologically non-specific globulins. It was shown that large numbers of cells may be labelled even though most of the cells had no overlying grains or only one or two. Extensive counting must be performed; and corrections can be made for radioactive background without recourse to elaborate computer programs. (UK)

7993 ANTIMONY AND TECHNETIUM SULFIDE FOR HEPATIC AND RENAL SCINTIGRAPHY. Morcellet, J. L.; Rousset, C.; Le Mignant, A. (Hopital d'Instruction des Armees Sainte Anne, Toulon Naval, France). J. Biol. Med. Nucl.; 7: No. 29, 33-39(1972). (In French).

A method of preparing technetium and antimony sulfide which is simple, very rapid, and inexpensive is presented. The precolloid of antimony sulfide can be conserved for 2 months. Labelling with ^{99m}Tc can be accomplished very rapidly. The product obtained can be used to produce high quality hepatic or renal scintigraphs. (FR)

7994 LABELED MOLECULES. Pichat, L. (CEN de Saclay, Gif-sur-Yvette, France). Sci. Progr. Decouverte; No. 3449, 11-18(Nov 1972). (In French).

Labeled molecules are used for very sensitive analysis of hormones and enzymes in biology and for the study of the biogenesis of natural substances in plants, mammals, and microorganisms. They are also used in pharmacology. The factors affecting the choice of labeled element are considered. Chemical methods for synthesizing labeled molecules are envisaged: labeling of molecules with ^{14}C performed by synthesis in which C–C bonds are created as exchange reactions are not possible; labeling of a molecule at stable positions by exchange reactions with tritium or tritiated water. Biochemical methods of preparing labeled molecules complete the chemical methods. Radiochemical purity controls are effected. Manufacturing costs are considered. (FR)

7995 BINARY SYSTEMS $ThCl_4$–Th AND $ThCl_4$–$ThOCl_2$. Chiotti, P.; Fuller, J. E.; Dock, C. H.; Jha, M. C. (Ames Lab., IA). J. Less-Common Metals; 31: No. 3, 365-376(Jun 1973).

The $ThCl_4$–Th system was investigated and the main features of the known $ThCl_4$–$ThOCl_2$ system confirmed. The $ThCl_4$–Th system is a simple eutectic system with a eutectic composition and temperature of 3.0 mole% Th and 700 ± 5°C, respectively. The only phases detected by x-ray-diffraction data were thorium and two crystalline forms of $ThCl_4$. No evidence was found for either $ThCl_3$ or $ThCl_2$. The $ThCl_4$–$ThOCl_2$ system is, similarly, a simple eutectic system with a eutectic temperature of 715–5°C and a eutectic composition of 13.0 mole% ThO_2. No phases other than $ThOCl_2$ and the two crystalline forms of $ThCl_4$ were detected in this system. The $ThCl_4$ transformation at 405 ± 5°C is very sensitive to dissolved impurities but it can be restored in both systems by annealing below 400°C. Consequently, the solubility of thorium or $ThOCl_2$ in $ThCl_4$ is very small at low temperatures. (auth)

7996 TECHNETIUM LABELING. Eckelman, W. C.; Richards, P. (to United States Atomic Energy Commission). U. S. Patent 3,725,295. 3 Apr 1973. Filed date 20 Jul 1971. 6p.

A method is presented that overcomes many of the problems connected with the preparation and use of tracer materials employing ^{99m}Tc as the radionuclide by providing an approach which eliminates the critical pH requirements of previous methods, is reliable, and facilitates in some embodiments the preparation of the complete solution except for the presence of the radionuclide in advance, so that at the time of use only the Tc need be added. It has been found that when the stannous ion is employed as the reducing agent for the Tc, reduction is not critically dependent on a particular pH, and that it can be carried out at a neutral value. In accordance with a preferred embodiment of the process, the stannous ion is employed as the reducing agent with the chelate diethylenetriaminepentaacetic acid (DTPA) for preparing a solution ready for the addition of $NaTcO_4$ when the pharmaceutical is to be used, for brain scanning or for visualizing kidney function. The stannous ion is also used in other embodiments such as with acid citrate dextrose (ACD) as a solution for use in the labeling of red blood cells. (auth)

7997 PREPARATION AND STRUCTURAL CHARACTERIZATION OF TRIS(BENZYLCYCLOPENTADIENIDE)CHLOROURANIUM(IV), $U(C_5H_4CH_2C_6H_5)_3Cl$. Leong, J.; Hodgson, K. O.; Raymond, K. N. (Univ. of California, Berkeley). Inorg. Chem.; 12: No. 6, 1329-1335(Jun 1973).

The compound tris(benzylcyclopentadienide)chlorouranium(IV), $U(C_5H_4CH_2C_6H_5)_3Cl$, was prepared and the crystal and molecular structure was determined from single-crystal, three-dimensional X-ray diffraction data collected by counter methods. The molecular structure consists of a uranium atom symmetrically bonded to the carbon atoms of three planar aromatic cyclopentadienide anions at an average U–C distance of 2.733(1) Å and to one chloride ion at 2.627(2) Å in a distorted tetrahedral geometry with approximately C_{3v} coordination symmetry. The uranium atom is located 0.428 Å above the plane defined by the centers of the three cyclopentadienide anions in contrast to a distance of 0.824 Å expected for tetrahedral geometry. The average C–C bond length in the three planar cyclopentadienide anions is 1.374(2) Å. The average C–C bond distance for the three planar benzene rings is 1.359(5) Å. Deep red trapezoidal prisms of $U(C_5H_4CH_2C_6H_5)_3Cl$ have the follow-

ing crystal data: monoclinic space group $P2_1/n$, cell constants a = 11.133(2), b = 16.275(3), c = 16.367(3) Å, β = 100.45(2)°, Z = 4, ρ_{obsd} = 1.68, and ρ_{calcd} = 1.68 g/cm³. The structure was refined by full-matrix, least-squares methods using 2964 independent reflections with $F^2 > 3\sigma(F^2)$ and a model which includes anisotropic thermal motion with fixed hydrogen positions to a standard unweighted R factor of 3.13%. (auth)

7998 REACTION OF THIOLS WITH THE ONE-EQUIVALENT OXIDANTS NEPTUNIUM(VI) AND CERIUM(IV) IN AQUEOUS ACIDIC MEDIA. Lavallee, D. K.; Sullivan, J. C.; Deutsch, E. (Univ. of Chicago). Inorg. Chem.; 12: No. 6, 1440-1443(Jun 1973).

Results show that in the reactions of the 1-equiv oxidants Np(VI) and Ce(IV) with thiols, the stoichiometry depends upon the initial concentration of thiol and the presence of β-carboxylate functions in the thiol. The presence of molecular oxygen in the solutions has an effect on both the dynamic and thermodynamic aspects of these reactions. (DHM)

7999 STRUCTURE OF TETRACYCLOPENTADIENYL-URANIUM(IV). Burns, J. H. (Oak Ridge National Lab., TN). J. Amer. Chem. Soc.; 95: No. 11, 3815-3817(30 May 1973).

Single-crystal x-ray diffraction study of $(C_5H_5)U$ shows that the lattice is body-center tetragonal and the unit cell with a = 8.635 and c = 10.542 Å contains two molecules. (DHM)

8000 RADIOACTIVE KRYPTONATES OF ORGANOSULFUR COMPOUNDS. VI. 4-(4-Substituted Benzylthio)phenylisothiocyanates, 4(Benzylsulfonyl)phenyisothiocyanate, and 4-Isothiocyanatophenyl-2-Substituted Sulfones. Uher, M.; Toelgyessy, J.; Jendrichovsky, J. (Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 14: No. 1, 69-75(25 May 1973).

The preparation of radioactive Kryptonates of isothiocyanates and study of their stability in air, water, water–acetone, and water–ethanol mixtures are described. (auth)

8001 SYNTHESIS AND PURIFICATION OF 6-FURFURYL-AMINOPURINE 11-^{3}H (KINETINE) OF HIGH SPECIFIC ACTIVITY. Buchman, O.; Milstein, D.; Shimoni, M. (Israel Nuclear Research Center-Negev, Beer Sheva, Israel). J. Label. Compounds; 9: No. 1, 73-79(1973). (In French).

The microsynthesis and purification of kinetin, labelled with tritium in the methylene group, are described. The specific activity obtained is 2.4 Ci/mmole. (auth)

8002 PREPARATION AND STABILITY OF Am(IV) AND Am(VI) IN PHOSPHORIC ACID SOLUTIONS. Myasoedov, B. F.; Mikhailov, V. M.; Lebedev, I. A.; Koiro, O. E.; Frenkel, V. Ya. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 14: No. 1, 17-24(25 May 1973).

The electrolytic Am(III) oxidation in solutions of phosphoric acid of different concentration was investigated. In 10 to 15M H_3PO_4 pure Am(IV) and in 2M H_3PO_4 pure Am(VI) are formed due to oxidation. The mechanism and kinetics of the reduction of Am(IV) and AM(VI) were studied. (auth)

8003 SPECIFIC ACTIVITIES OF CARRIER-FREE RADIOISOTOPE PREPARATIONS. Willis, J. N. (National Marine Fisheries Service, Beaufort, NC). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 354(Jun 1973).

Measurements are reported of the specific activities of five samples of "carrier-free" ^{65}Zn stock solutions obtained from three commercial suppliers. The high concentrations of stable Zn found in two of the samples were such as to alter the natural Zn exchange equilibrium in any tracer study where large quantities of isotope were required to obtain accurate measurements of radioactivity in small samples. The results indicate, that whenever "carrier-free" radioisotopes are to be used as tracers in natural systems, the specific activities should be determined before use, in order to ascertain the extent to which the existing natural equilibria would be disturbed by the simultaneous introduction of stable element into the system along with the tracer. (UK)

8004 REDOX REACTIONS OF ACTINIDE ELEMENTS. XIX. Mechanism of Charge Transfer in Solutions. Rykov, A. G.; Timofeev, G. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 724-728(1972).

Translated from Radiokhimiya; 14: No. 5, 703-708(1972).

A model of "long range" charge transfer in aqueous solutions, based on the assumption of the possibility of electron conductivity in liquid condensed systems with strong intermolecular interactions, is proposed. It was found that such a model gives an uncontradictory explanation for the experimental data on the thermodynamics of cation–cation redox reactions that do not agree with the theories of "short range" charge transfer. The effect of D_2O (as compared to H_2O) on the rate of reaction was studied and the K_H/K_D at 25°C calculated. (JGG)

8005 CHEMICAL CONSEQUENCES OF THE ISOMERIC CONVERSION OF ^{127m}Te CONTAINED IN COMPOUNDS OF TETRAVALENT TELLURIUM. Zaitsev, V. M.; Gusel'nikov, V. S.; Makhomalkina, S. M. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 812-815(1972).

Translated from Radiokhimiya; 14: No. 5, 783-786(1972).

The chemical consequences of the isomeric conversion of ^{127}Te contained in compounds of tetravalent tellurium under various conditions were studied using the method of thin layer chromatography. It was found that in the decay of ^{127}Te(IV) in solutions of NaOH and HNO_3, part of the daughter atoms of ^{127}Te are stabilized in the form of Te(VI), which permits an effective separation of the nuclear isomers of tellurium. (auth)

8006 INFRARED SPECTRUM OF MATRIX-ISOLATED URANIUM OXIDE VAPOR SPECIES. Gabelnick, S. D.; Reedy, G. T.; Chasanov, M. G. (Argonne National Lab., IL). Chem. Phys. Lett.; 19: No. 1, 90-93(1 Mar 1973).

The mid-infrared spectra of UO_2 and UO_3 formed by vaporization of UO_{2+x} and trapped in argon matrices were obtained. A study of the spectra of the normal ^{16}O and isotopically substituted ^{18}O species as a function of temperature and composition of the condensed uranium oxide has led to the following assignments for the ^{16}O species: $UO_2(\nu_3)$ = 776.1 cm^{-1}, $UO_3(\nu_3)$ = 852.5 cm^{-1}, $UO_3(\nu_1)$ = 745.6 cm^{-1}. On the basis of the isotopic data, a bond angle for UO_2 of 180 + 0 – 10° and a value of $UO_2(\nu_1)$ of 765.3 cm^{-1} were calculated. (auth)

8007 REDOX REACTIONS OF ACTINIDE ELEMENTS. XVIII. Influence of Acidity on Rate of Cation–Cation Reactions. Rykov, A. G.; Timofeev, G. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 718-723(1972).

Translated from Radiokhimiya; 14: No. 5, 697-703(1972).

An analysis of the experimental data on the influence of acidity on the rate of cation–cation reactions of the actinide elements shows that the effective activation energy does not depend on the hydrogen ion concentration, and that the change in the reaction rate with changing acidity is due to a change in entropy of activation. Kinetic schemes including preliminary hydrolysis of cation reactants do not permit a noncontradictory explanation to be given for the entire aggregate of experimental data. (auth)

8008 REDOX REACTIONS OF ACTINIDE ELEMENTS. XIV. Entropies and Enthalpies of Activation of Cation–Cation Reactions of Uranium and Neptunium. Rykov, A. G.; Timofeev, G. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 714-717(1972).

Translated from Radiokhimiya; 14: No. 5, 693-696(1972).

It was established that for cation–cation reactions of uranium and neptunium a linear relationship is observed between the standard entropies and enthalpies of activation: $\overline{\Delta H^*} = \overline{\Delta H_0^*} + T_0\overline{\Delta S^*}$. For reactions of the type of $M^{4+} + X^{p+}$ and $MO_2 + Y^{q+}$, the standard entropies of activation coincide in sign and magnitude with the final changes in the entropy for cation reactants that do not change their structure during the reaction, X^{p+} or Y^{q+}. For each of the families of reactions (uranium or neptunium), the constant $\overline{\Delta H_0^*}$ is close to the free energy change corresponding to the potential of the couple M(IV)–M(V). (auth)

8009 SPECTROPHOTOMETRIC STUDY OF COMPLEX FORMATION AND SOLVATION OF IONS OF ACTINIDE ELEMENTS. IV. Interaction of Neptunium(V) with Ions of Uranium(IV), Iron(III), and Thorium(IV). Rykov, A. G.; Frolov, A. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 729-736(1972).

Translated from Radiokhimiya; 14: No. 5, 709-717(1972).

It was established that in solutions of uranium(VI), iron(III), and thorium(IV) salts, neptunium(V) exists in only two spectrally different forms. An equation relating the degree of conversion of neptunium(V) from one form to another to the total concentration of the active cation (UO^{2+}, Fe^{3+}, or Th^{4+}) was found. It was found that the influence of the active cations on the absorption spectrum of neptunium(V) depends both on the nature and on the concentration of the anions present in solution but does not depend on the total ionic strength of the solution. (auth)

8010 SPECTROPHOTOMETRIC STUDY OF COMPLEX FORMATION AND SOLVATION OF IONS OF THE ACTINIDE ELEMENTS. V. Interaction of Neptunium(V) with Iron(III) Ions in Mixed Solvents. Rykov, A. G.; Frolov, A. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 737-740(1972).

Translated from Radiokhimiya; 14: No. 5, 717-721(1972).

It was established that in mixed solvents (water–methanol, water–ethanol, water–acetone) that the interaction of neptunium(V) with iron(III) ions obeys the same principles that were found for aqueous solutions. The degree of interaction between neptunium(V) and iron(III) ions is inversely proportional to the effective dielectric constant of the solvent. It is hypothesized that the specific interaction of neptunium(V) with active multiply charged cations is analogous in nature to cation–cation redox reactions, and not to reactions of complex formation. (auth)

8011 ENTHALPY OF FORMATION OF URANIUM TRIOXIDE HEMIHYDRATE. Santalova, N. A.; Vidavskii, L. M.; Dunaeva, K. M.; Ippolitova, E. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 741-745(1972).

Translated from Radiokhimiya; 14: No. 5, 721-726(1972).

The enthalpy of the reaction of two samples of uranium trioxide hemihydrate with composition $UO_3 \cdot 0.393\ H_2O$ and $UO_3 \cdot 0.648\ H_2O$ with a solution of hydrofluoric acid, equal to -21.7 ± 0.08 and -20.83 ± 0.10 kcal/g-atom U, respectively, at 298.15°K, was measured by a calorimetric method. The enthalpy of formation of compounds belonging to the phase of uranium trioxide hemihydrate from uranium trioxide and water, as a function of the composition, was represented by a linear equation. For the stoichiometric compound, this value is equal to -3.19 ± 0.10 kcal/g-atom U. Using the literature data the standard enthalpy of formation of uranium trioxide hemihydrate from the elements was calculated to be -333.15 ± 0.46 kcal/g-atom U at 298.15°K. (auth)

8012 CRYSTAL STRUCTURE OF SODIUM DIURANATE. Kovba, L. M. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 746-749(1972).

Translated from Radiokhimiya; 14: No. 5, 727-730(1972).

A repeated x-ray diffraction study of sodium and potassium diuranates was made; the lattice parameters of these compounds were refined. The structure of sodium diuranate was studied, and it was found that this compound contains pseudohexagonal uranyl–oxygen layers $(UO_2)_2O_3$, which include all the uranium atoms. (auth)

8013 PHOTOCHEMICAL REDUCTION OF URANYL ACETATE BY FORMALIN AND ETHANOL. Kireeva, G. N.; Mikulenok, G. E.; Savel'eva, V. I. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 757-759(1972).

Translated from Radiokhimiya; 14: No. 5, 738-741(1972).

The behavior of uranyl acetate solutions under the action of light of a PRK-2 mercury-quartz lamp in the presence of ethanol and formalin was investigated. The influence of the temperature and the acetic acid concentration on the photochemical reduction of these solutions was demonstrated. The quantum yields of the reaction in the temperature interval 10 to 50°C were determined. (auth)

8014 IONIZATION POTENTIALS OF p-ELEMENTS OF SEVENTH PERIOD. Bogdanov, R. V. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 763-765(1972).

Translated from Radiokhimiya; 14: No. 5, 744-746(1972).

Two approaches to the selection of values of ionization potentials of the transactinide elements are discussed. They are based on an analysis of principles of variation of the properties of atoms in Mendeleev's periodic system, taking into consideration the increase in ionization potential with increasing charge in the nucleus (Z) in the period and a drop in the ionization potential in the group in connection with an increase in the principle quantum number and size of the atoms. (JGB)

8015 SIGN OF CHARGE OF ASTATINE ION IN SOLUTIONS. Do Kim Tyung; Dudova, I. V.; Khalkin, V. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 790-792(1972).

Translated from Radiokhimiya; 14: No. 5, 766-767(1972).

The sign of the charge of the astatine ion was studied by the method of electromigration in dilute aqueous solutions of $HClO_4$ $H_2Cr_2O_7$. Astatine was isolated from thorium irradiated with 660 MeV protons. It is concluded that bichromate oxidizes astatine and At(0) to a valence state that forms positively charged ions. This state is identical to that found previously in HNO_3 solutions. (JGB)

8016 KINETICS OF REACTION OF URANIUM(IV) WITH CERIUM(IV) IN SOLUTIONS OF TRIBUTYL PHOSPHATE. Frolova, L. M.; Lakaev, V. S.; Timofeev, G. A.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 786-787(1972).

Translated from Radiokhimiya; 14: No. 5, 763-764(1972).

The kinetics of reactions of the type of $M^{4+} + X^{+p} \rightarrow MO_2^{+}$ (or $MO_2^{3+} + X^{+p-1}$) with $M^{4+} = U^{4+}$ and $X^{+p} = Ce^{4+}$ were studied in solutions of TBP (diluent CCl_4) by a spectrophotometric method. The course of the reaction was followed according to the change in the absorption band of cerium(IV) with time; the optical density of the solutions was measured at 290 to 470 nm. The concentration of cerium(IV) and uranium(IV) in the kinetic experiments was (0.5 to 7.0) $\cdot 10^{-3}$ M and (0.2 to 3.0) $\cdot 10^{-3}$ M, respectively. The effective activation energy of the reaction studied in solutions of TBP ($E_a = 13.0 \pm 1.0$ kcal/mole) is close to the previously reported activation energy in aqueous solutions ($E_a = 14.6$ kcal/mole and is practically independent of the TBP concentration and acidity. Consequently, the change in the rate with changing composition of the solutions is basically due to a change in the entropy of activation of the reaction. The apparent order of the reactions with respect to the hydrogen ion concentration reflects the degree of influence of the change in the chemical potential of hydrogen ions on the probability of occurrence of the reaction, and in general is not related to the stoichiometric coefficient of H^+ ions in the summary reaction equation. The rate of the reaction of uranium(IV) and cerium(IV) increases with increasing water concentration in the organic phase. (JGB)

8017 ELECTRON-TRANSFER AND F–D ABSORPTION BANDS OF SOME LANTHANIDE AND ACTINIDE COMPLEXES AND STANDARD (II-III) OXIDATION POTENTIAL FOR EACH MEMBER OF LANTHANIDE AND ACTINIDE SERIES. Nugent, L. J. (Oak Ridge National Lab., TN); Baybarz, R. D.; Burnett, J. L.; Ryan, J. L. J. Phys. Chem.; 77: No. 12, 1528-1539(7 Jun 1973).

A powerful new correlation technique is introduced. It is based on the theoretical and experimental results of atomic spectroscopy, and it is shown to be generally applicable for intraseries correlations of various physical and chemical properties, such as oxidation potentials, first electron-transfer absorption-band energies, and first f–d absorption-band energies of the compounds and complexes of the lanthanide and actinide series. For many of the members of these series representative values of some of these properties were available from the literature; for others new measurements were made, so that sufficient data are available to provide a test of the general validity of the theory, and hence, to calculate many of these properties for all the members of both series. The most important new results of this work are the determination or verification of the following standard oxidation potentials: $E°Sm(II-III) = +1.55$, $E°Eu(II-III) = +0.35$, $E°Tm(II-III) = +2.3 \pm 0.2$, $E°Yb(II-III) = +1.15$, $E°Am(II-III) = +2.3 \pm 0.2$, $E°Es(II-III) = +1.2 \pm 0.2$, $E°Fm(II-III) = +1.1 \pm 0.2$, $E°Md(II-III) = +0.15$, and $E°No(II-III) = -1.45$, each in volts relative to the standard oxidation potential of the normal hydrogen electrode. (auth)

8018 METAL CHLORIDE–GRAPHITE COMPOUNDS FROM NONAQUEOUS SOLVENTS. Intercalation from thionylchloride Solutions. Boeck, A.; Ruedorff, W. (Univ., Tuebingen, Ger.). Z. Anorg. Allg. Chem.; 397: No. 2, 179-186(Mar 1973). (In German).

The intercalation of UCl_5, $AlCl_3$, $NbCl_5$, $TaCl_5$, and $MoOCl_4$ in graphite from $SOCl_2$ solutions is investigated. From concentrated UCl_5 solutions, dependent on the temperature, two compounds are obtained: UCl_5–graphite and UCl_5–$SOCl_2$–graphite, both with the structure of a first intercalation stage. The other metal chlorides are intercalated without $SOCl_2$: $AlCl_3$ to a second stage; $NbCl_5$, $TaCl_5$ and $MoOCl_4$ to a third stage. Chlorine additionally bound in the $AlCl_3$, $NbCl_5$ and $TaCl_5$ compounds results from a decomposition reaction of the $SOCl_2$. (auth)

8019 COMPUTER CONTROL OF ISOTOPE SUPPLIES. Ammende, H. P. Angew. Inform.; No. 10, 469-471(1972). (In German).

A system of computer programs developed for control of a stock of radioactive substances used in nuclear medicine is described. The programs are written in a dialogue mode and can be run from terminals under control of a multiprogramming operating system. The main operations of the programs are: Generation of the disk files, bookkeeping (putting in store, withdrawal from stock, calculation of the loss caused by radioactive decay) and automatic output of order forms or paper tapes which are fed into a teletypewriter of the Telex system. (auth)

8020 TRANSURANIUM ELEMENTS. Part C. Compounds. Koch, G. Gmelins Handbook of Inorganic Chemistry. New Supplement Series. Volume 4. Weinheim, Ger.; Verlag Chemie GmbH (1972). 298p. (In German and English). DM 386,–.

A book on transuranium element compounds is presented with chapters on compounds with rare gases, compounds with hydrogen, compounds with oxygen, ternary and polynary oxides and oxide phases, compounds with nitrogen, compounds with fluorine, compounds with chlorine, compounds with bromine, compounds with iodine, compounds with sulfur, compounds with selenium, compounds with tellurium, compounds with carbon, compounds with silicon, compounds with phosphorus, compounds with arsenic, compounds with germanium, complex compounds with neutral and chelating ligands, and organometallic compounds. (DHM)

8021 MICRODISTRIBUTION OF THORIUM ISOTOPES ON SURFACE COATINGS AND SURFACE DEACTIVATION. Cherkashina, T. N.; Pavlovskaya, N. A.; Moiseitsev, P. I.; Korobkov, V. I. Gig. Sanit.; No. 4, 46-49(Apr 1973). (In Russian).

The authors determined relation existing in between microdistribution of thorium isotopes on surfaces and their possible deactivation. Surfaces with local distribution of thorium along the perimeter or as a single active spot may be deactivated completely. However, surfaces with disseminated distribution of the

isotopes are much more difficult to deactivate. Study of microdistribution of thorium isotopes gives an idea of the surface structure and that of specific links existing between the element and the material of the surface. (auth)

Radioactive Waste Treatment

8022 (GERHTR-83) OFF-GAS TREATMENT AND KRYPTON DISPOSAL IN HTGR-FUEL ELEMENT REPROCESSING. Laser, M.; Beaujean, H.; Bohnenstingl, J.; Filss, P.; Heidendael, M.; Mastera, St.; Merz, E.; Vygen, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Chemische Technologie). 1972. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

Krypton, tritium, and iodine are separated from burner off-gas by CO_2-liquification and rectification at room temperature. Krypton is concentrated in the lower boiling fraction, while tritium and iodine are concentrated in the higher boiling fraction (AKUT-process). The dissolver off-gas is decontaminated by a cryogenic process. Based on safety and economy, the disposal of compressed krypton confined in steel cylinders by dumping in the deep sea is preferred to the long term overground bunker storage. The estimated costs are: 1.3×10^{-3} Dpf/kWh for cleaning the burner off-gas; 1×10^{-4} Dpf/kWh for dissolver off-gas cleanup; 2.8×10^{-5} Dpf/kWh for krypton disposal into the deep sea, and 2.4×10^{-4} Dpf/kWh for the long term overground krypton storage. (auth)

8023 (LFEN-RI-7) ANALYSIS OF THE PROJECT FOR RADIOACTIVE WASTE FIXATION TREATMENT WORKED OUT IN DETAIL BY THE FIRM POTASSE AND ENGRAIS CHIMIQUES AND THE LABORATORY OF PHYSICS AND NUCLEAR ENGINEERING. Sequeira, F.P.C. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 72p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $5.75.

A critical analysis is made of the radioactive waste processing installation developed by Potasse and Engrais Chimiques. The analysis is a technical–economic one. The composition and activity of the radioactive wastes considered for the installation are described. The installation design is then described in detail. The processing of both liquid and solid wastes is considered. (JSR)

8024 REMOVAL OF XENON AND RADON FROM CONTAMINATED ATMOSPHERES WITH DIOXYGENYL HEXAFLUOROANTIMONATE, O_2SbF_6. Stein, L. (Argonne National Lab., IL). Nature (London); 243: No. 5401, 30-32(4 May 1973).

It has been previously shown that radon can be removed from contaminated atmospheres by treatment with liquid BrF_3 and solid halogen fluoride–metal fluoride complexes. Further experiments are reported using a dioxygenyl compound, O_2SbF_6, that reacts with Rn and Xe at about 25°C, and appears very promising as a reagent for removing both of these gases from contaminated atmospheres. Dioxygenyl hexafluoroantimonate was used, prepared by photochemical reaction of O_2, F and SbF_5. Rn reacted immediately to form a nonvolatile compound, while Xe also reacted similarly. There was no reaction with Kr even up to 150°C. Experimental details are described, and results shown in tabular form. Reaction mechanisms are discussed. The dioxygenyl compound appears to be a very "clean" reagent for air purification purposes, and is less corrosive than some other complex fluorides; it is decomposed by moisture, and in treatment of wet gases it must be used in conjunction with a desiccant. (UK)

8025 METHOD AND DEVICE FOR THE INCORPORATION OF RADIOACTIVE WASTES IN BITUMEN OR SIMILAR MATERIAL. Schmal, W.; Becht, W. (to Metallgesellschaft AG). German Patent 1,614,130. 20 Aug 1970. Filed date 2 Mar 1967. 17p. (In German).

A method for the incorporation of radioactive wastes into materials which are liquid at high temperature and solid at normal temperature is described. The radioactive waste is applied to the constantly renewed surface of the liquid material. The radioactive waste is applied to a layer flowing over and under and is applied in such a way that the specific surface charge is kept small. The device for carrying out this procedure consists of a sealed container, a heater, and a rotator for the liquid material, and a dispersion device for the radioactive wastes. The liquid is dispersed on the internal wall of the container by the rotator. The liquid is so dispersed that it runs down in thin layers on the internal walls of the container. The radioactive wastes are sprayed on the surface of the liquid layer by a fixed rotating sprayer. A baffle is built into the container and the liquid runs down its surface. The container and the baffle are constructed to rotate symmetrically. The heater is built within the container; and the rotator is fixed within the container. The rotator and the sprayer are fixed to the same wall, and the liquid is rotated in forced rotation. The liquid in the container in the space between the container wall and baffle is pumped in forced rotation. (JSR)

8026 METHOD FOR THE CONCENTRATION OF RADIOACTIVE WASTES. Doellgast, W.; Zieten, W. (to Siemens AG). German Patent 1,614,497. 20 Aug 1970. Filed date 12 Apr 1967. 15p. (In German).

A method for the concentration of volative, liquid radioactive wastes is described. The liquid radioactive wastes are introduced into a storage vessel in fine dispersions and vaporized or evaporated in a closed circuit of circulating hot air current. The residue is embedded in layers in a water-insoluble material such as paraffin or bitumen. (JSR)

8027 SEPARATION OF ACTINIDES AND LANTHANIDES ON ZIRCONIUM PHOSPHATE. III. ISOLATION OF CERIUM(IV). Shafiev, A. I.; Efremov, Yu. V. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 798-799(1972).

Translated from Radiokhimiya; 14: No. 5, 771-773(1972).

Cerium(IV) and other tetravalent elements can be quantitatively sorbed from acid solutions in the presence of an oxidizing agent on a small column with zirconium phosphate. Washing the column with 1N HNO_3 in the presence of an oxidizing agent permits the achievement of a high degree of purification (more than 10^7) from a number of di-, tri-, and hexavalent elements. Concentration in two to three free column volumes is achieved on account of the rapid reduction of Ce(IV) by a solution of 1N HNO_3–1 to 2% H_2O_2. (auth)

8028 REDUCTION OF VOLUME OF HYDROXIDE PULPS BY FREEZING. Zolotavin, V. L.; Sanatina, V. N.; Konstantinovich, A. A.; Brovkova, E. V. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 819-821(1972).

Translated from Radiokhimiya; 14: No. 5, 788-790(1972).

Results indicate that freezing and thawing of ferric hydroxide pulps appreciably reduce their moisture content (from 99 to 92 to 95%) and produce a 15 to 30 fold reduction in volume. The pulp acquires a sandy structure, which sharply improves its filtering properties. Freezing and thawing followed by vacuum filtration of the pulp reduce moisture content from 99 to 70% and volume by 150 to 200 fold. (JGB)

Radioisotope Production

8029 (ARH-SA-149) APPLICATION OF AMBERLITE XE-270 RESIN TO PURIFICATION OF NEPTUNIUM. Schulz, W. W. (Atlantic Richfield Hanford Co., Richland, Wash). May 1973. 41p. Dep. NTIS $4.25.

Amberlite XE-270, a macroreticular weak-base ion exchange resin made by the Rohm and Haas Company, was used successfully over an eight-month period in the Hanford Purex plant to purify about eight kg of neptunium-237. Details of the plant experience, as well as the many laboratory-scale tests which preceded plant-scale operation, are described. For routine purification of ^{237}Np the Amberlite XE-270 resin provides four important advantages over conventional microreticular strong base resins used heretofore: greatly improved thorium decontamination performance, a much sharper neptunium elution band, operation at 25°C rather than at 40 or 50°C, and a five-fold lower resin cost. (auth)

8030 APPLICATION OF SHORT-LIVED RADIOACTIVE ISOTOPES PRODUCED BY THE CYCLOTRON TO MOESSBAUER EFFECT. Ambe, F. (Inst. of Physical and Chemical Research, Wako, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 258-260 (Apr 1972). (In Japanese).

From 10th conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The measurement of the absorption spectra of ^{61}Ni with ^{61}Cu as the source and the emission spectra of ^{119}Sn with ^{119}Sb and ^{119m}Te as sources is described. The short-lived isotopes were produced with an IPCR 160-cm cyclotron at the Institute of Physical and Chemical Research. The ^{61}Cu was obtained by bombarding Ni–V alloy with α particles accelerated with the cyclotron. The internal magnetic field at the position of nuclei of Ni ions was determined in spinel-type nickel oxides ($NiFe_2O_4$, $NiMn_2O_4$, $NiCo_2O_4$, Ni_2GeO_4, $NiCr_2O_4$, and $NiRh_2O_4$). Secondly, ^{119}Sb and ^{119m}Te were obtained by bombarding tin plates of natural isotope composition with p, d, or α particles. Typical ^{119}Sn-Moessbauer emission spectra of antimony and tellurium compounds were obtained at liquid nitrogen temperature. Moessbauer parameters of the ^{119}Sn emission spectra of ^{119}Sb-labeled antimony compounds and ^{119m}Te-labeled tellurium compounds are also determined. (Japan)

8031 GENERATOR SUBSTANCE FOR THE PREPARATION OF RADIOACTIVE ^{137m}Ba. Lieser, K. H.; Bernhard, H. (to EURATOM). German Patent 1,814,665. 1 Oct 1970. Filed date 12 Dec 1968. 2p. (In German).

A generator substance for the separation of radioactive ^{137m}Ba by elution with diluted hydrochloric acid was described. The generator is characterized by a carrier whose surface is coated with a thin layer of iron hexacyanoferrate. The carrier is iron or steel. The method for the continuous preparation of ^{137m}Ba from ^{137}Cs is described. The ^{137}Cs from the generator substance was fixed and the ^{137m}Ba was eluted with diluted mineral acid. (JSR)

8032 METHOD FOR THE SEPARATION OF AMERICIUM AND CURIUM FROM AQUEOUS SOLUTIONS OF IRRADIATED FUELS. Koch, G. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,813,441. 25 Jun 1970. Filed date 7 Dec 1968. 14p. (In German).

A method for the separation of americium, curium, and similar actinides from aqueous solutions, which in addition to these actinides can contain a series of impurities and admixtures such as rare earth metals, is described. The solutions considered are especially those highly active wastes coming from the processing of fuel and breeder materials. These actinides are extracted from aqueous weakly acid solutions in the usual manner together with the rare earth metals by means of an acid phosphororganic extraction agent which is diluted with an inert aromatic or aliphatic solvent and is modified if necessary with solubility-increasing additions. From this phosphororganic phase containing essentially the actinides and the rare earth metals only the actinides are selectively reextracted by means of an aqueous weakly acid carboxylic acid solution which contains a complexing agent of the aminopolyacetic acid type. The extraction agent is purified of the usual extracted metal ions. For the selective reextraction with the weakly acid carboxylic acid solution containing a complexing agent, a mixture of lactic acid and diethylenetriaminepentaacetate, whose pH value is approximately 3, is used. In addition to the use of lactic acid as the reextraction agent glycolic acid, citric acid, tartaric acid, and glycin are also used. Nitrilotriacetate is also used as complexing agent. (JSR)

8033 PURIFICATION OF LANTHANIDE AND ACTINIDE ELEMENTS FROM TRACE IMPURITIES OF LEAD. Buklanov, G. V.; Gavrilov, K. A.; Korotkin, Yu. S. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 796-797(1972).

Translated from Radiokhimiya; 14: No. 5, 770-771(1972).

In the production of new transuranium elements with $z \geq 101$ in reactions of accelerated multiply charged ions with nuclei of heavy elements (Pu, Am, Cm), the most important factor is the purity of the cyclotron targets with respect to impurities of lead, the content of which should not exceed 10^{-6} g/g. Methods of extraction and coprecipitation of lead with colloidal collectors (sulfides) were investigated. The methods of purification of Am and Pu from lead were worked out on lanthanum and uranium. Results of the coprecipitation of Pb with Ag_2S were sufficient to permit preparation of cyclotron targets with ^{243}Am and ^{242}Pu with Pb content $< 10^{-6}$ g/g. (JGB)

8034 CONCENTRATION OF CESIUM AND FRANCIUM BY PARTITION AND ADSORPTION CHROMATOGRAPHY. Mal'tseva, N. S.; Gavrilov, K. A. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 800-804(1972).

Translated from Radiokhimiya; 14: No. 5, 773-778(1972).

Methods of concentration of cesium and francium by means of partition and adsorption chromatography from products of nuclear reactions were developed. The proposed methods are based on the use of selective methods of separation of Cs and Fr from other radioactive elements (Ra, Rb, Sc, Ba, U, Th, etc.) for the coprecipitation of Cs and Fr with silicotungstic acid, followed by extraction and adsorption chromatography. The possibility of obtaining concentrated solutions of cesium and francium with and without a carrier was demonstrated. (JGB)

8035 SEPARATION OF HETEROVALENT ELEMENTS ON CALCIUM FLUORIDE. Shafiev, A. I.; Goncharov, V. A.; Bevz, A. S.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 805-807(1972).

Translated from Radiokhimiya; 14: No. 5, 778-780(1972).

The influence of the method of production and treatment of calcium fluoride on its adsorption properties was demonstrated. Tri- and tetravalent actinides and lanthanides are sorbed on calcium fluoride from solutions with pH = 2 to 3; they can be desorbed only with solutions of the complex formers or by partially dissolving the sorbent by the action of concentrated HNO_3. M(I), (II), (V), (VI) ions are not sorbed on calcium fluoride. (auth)

8036 ISOLATION OF GERMANIUM-68 WITHOUT CARRIER. Levin, V. I.; Sokolov, S. V. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 808-811(1972).

Translated from Radiokhimiya; 14: No. 5, 780-783(1972).

Certain methods of dissolution of targets of irradiated zinc were investigated. A method of isolation of germanium-68 without a carrier from zinc irradiated with α particles on a cyclotron was developed. A method of production of germanium-68 without a carrier from gallium irradiated with protons on a cyclotron was also developed. The method ensures a technological yield of germanium-68 of no less than 90%; the radioisotopic purity of the preparation is no less than 99.99%. A method of investigation of the radioisotopic purity of a preparation of germanium-68 is proposed. (auth)

8037 PREPARATION OF INDIUM-111 LABELLED BLEOMYCIN FOR TUMOUR LOCALIZATION. Thakur, M. L. (Hammersmith Hospital, London). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 357-359(Jun 1973).

From a study of ways in which bleomycin (BLM) may be labelled with short lived (hours) radionuclides of both bivalent and trivalent elements it was found that ^{111}In was the nuclide of choice. Production of the nuclide and subsequent labelling of BLM is described. The final injectable product contained about 1 mCi ^{111}In per mg of BLM per ml of 0.9% NaCl. Checking of the radiochemical purity is described. Gallium 67 can be chelated with BLM just as effectively, using the same procedure, and ^{99m}Tc can also label BLM in a similar manner after reduction with stannous chloride. (UK)

8038 PRODUCTION AND SEPARATION OF CYCLOTRON PRODUCED DYSPROSIUM-157. Thakur, M. L.; Waters, S. L. (Medical Research Council, London). J. Inorg. Nucl. Chem.; 35: No. 6, 1787-1791(Jun 1973).

A method was developed to produce ^{157}Dy with the alpha particle bombardment of natural gadolinium. The excitation function for the nuclear reactions producing this radionuclide was determined and the threshold energy is found to be about 15 MeV. A method is described for the isolation of the clinical product, together with details of its radiochemical and chemical purity. (auth)

8039 TIN-117m: PRODUCTION, CHEMISTRY, AND EVALUATION AS A BONE-SCANNING AGENT. Yano, Y.; Chu, P.; Anger, H. O. (Univ. of California, Berkeley). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 319-325(Jun 1973).

Cyclotron and nuclear reactor methods of producing ^{117m}Sn were compared. Reactor production gave the highest yield. Of several chelates studied, in rats ^{117m}Sn tartrate gave the highest bone uptake (55%) with less than 5% uptake in soft tissue. Because of a favorable half-life of 14 days and emission of 158 keV photons, ^{117m}Sn is considered as a possible bone-scanning agent. Scintillation camera and whole-body scan pictures show uptake of ^{117m}Sn-tartrate in bone of beagle dogs. Radionuclidic purity, chemical toxicity, and absorbed radiation dose are within limits acceptable for human use. (auth)

Reactor Fuel Reprocessing

Refer also to abstract 8159.

8040 (PNCT-841-72-14) EXTRACTION PROCESSES ON REPROCESSING OF FAST REACTOR FUEL IN A PUREX PLANT CONSTRUCTED FOR LIGHT WATER REACTOR FUEL. Gonda, K.; Yasu, S.; Kawashima, N.; Hoshino, T.; Tanaka, C. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). May 1972. 25p. NTIS (U. S. Sales Only).

The extraction processes on reprocessing Japanese Experimental Fast Reactor (JEFR, named as JOYO) fuel were studied with an unirradiated uranium and plutonium, supposing that the JEFR fuel will be treated with no modification of the facilities and the operation conditions except the solvent employed and the dilution of the fuel in the PNC Purex plant under construction for the exclusive use of light water reactor fuels. The applicability of the extraction facilities in PNC plant to the extraction of JEFR fuel was verified, concerning the recoveries of uranium and plutonium in the co-decontamination cycle, even in the case that the solvent was changed to 10% TBP from 30% TBP employed in a light water reactor fuel reprocessing. Also, the validity of 30% TBP system on the partition cycle of uranium and plutonium was confirmed with regard to stripping plutonium. (auth)

8041 (TID-26337) SEPARATION OF KRYPTON AND XENON FROM REACTOR ATMOSPHERES BY SELECTIVE PERMEATION. Second Comprehensive Progress Report, January 1, 1971 – June 30, 1972. Stern, S. A.; Sen, S. K.; Rao, A. K. (Syracuse Univ., N. Y. (USA). Dept. of Chemical Engineering and Materials Science). Mar 1973. Contract AT(30-1)-4057. 77p. Dep. NTIS $6.00.

Permeability, diffusion, and solubility coefficients were determined by the "time-lag" method for O_2, N_2, Ar, Kr, Xe, and CO_2 in symmetric cellulose acetate membranes, in the temperature range from −5° to 85°C, and at subatmospheric pressures. A detailed analysis of these data, and of other derived solution and diffusion parameters, shows that the transport of gases across symmetric membranes is controlled by molecular diffusion through the polymer matrix, with solution equilibrium established at the

membrane interfaces. The diffusion process appears to occur by molecular "jumps" between preexisting cavities in the polymer, possibly across single cellulose acetate chains. This diffusion mechanism is speculative, because of the possibility that the diffusion coefficients may have been affected by adsorption and immobilization of a fraction of the penetrant molecules in the polymer. The temperature dependence of the experimental diffusion coefficients can be represented satisfactorily by Fujita's "free volume" model. Cellulose acetate was found to undergo two second-order transitions in the presence of penetrants, one between 60° and 70°C and the other near 15°C. The permeation of the above gases through dry, asymmetric cellulose acetate membrane was measured in the same temperature and pressure range. The measurements show that significant structural differences must exist between the symmetric membranes and the dense surface layer of the asymmetric membranes. The mechanism of permeation through the latter appears also to be controlled by molecular diffusion, through the matrix of their dense surface layer, but is modified by another transport mechanism, probably some type of pore diffusion. Possible causes for the structural differences between the two types of membranes are discussed, as well as their implications to the uses of asymmetric membranes as gas separation barriers. Permeability, diffusion, and solubility coefficients were also determined for O_2, N_2, Kr, Xe, and CO_2 in symmetric ethyl cellulose membranes between 0° and 65°C and at subatmospheric pressures. The permeability coefficients are about an order of magnitude larger than those obtained with cellulose acetate membranes at comparable temperatures. The higher permeability coefficients for ethyl cellulose are due to higher penetrant diffusivities, rather than solubilities. The mechanism of penetrant diffusion appears to be similar to that proposed for cellulose acetate but is subject to the same uncertainty. Ethyl cellulose exhibits a single second-order transition in the experimental temperature range, between 22° and 35°C. Permeation rates of O_2, N_2, Ar, Kr, Xe, and CO_2 through dry, asymmetric ethyl cellulose membranes were measured at approximately the same temperatures and pressures. Significant differences were observed in the permeabilities of the symmetric and asymmetric ethyl cellulose membranes to different gases. This indicates that marked structural differences must exist between the former membranes and the dense surface layer of the latter, as in the case of cellulose acetate. The permeability of asymmetric cellulose acetate and ethyl cellulose to Kr, Xe, O_2, and N_2, and their selectivity for Kr and Xe relative to O_2 and N_2, were compared with similar data for silicone rubber. It was concluded that silicone rubber remains the best membrane material available at present for the separation of krypton and xenon from air by selective permeation. Finally, it is suggested that this process could become competitive with conventional separation processes with the development of permeators using hollow silicone rubber fibers as permselective barriers.(auth)

8042 CONVERSION OF FUEL-METAL NITRATE SOLUTIONS TO OXIDES. Haas, P. A. (to United States Atomic Energy Commission). U. S. Patent 3,725,293. 3 Apr 1973. Filed date 11 Jan 1972. 8p.

A single-step method is presented for converting an aqueous nuclear fuel metal nitrate solution to a fuel-metal oxide. A nitrate-reducing agent selected from the group consisting of hydroxylated organic compounds and hydrazine is added to the nitrate solution. The solution containing the additive is heated to an elevated temperature under pressure until the fuel-metal oxide is precipitated. The precipitated oxide is then recovered. The process may be applied to nitrate solutions of U, Th, and Pu. (auth)

8043 METHOD FOR DISSOLVING MOLYBDENUM AND TUNGSTEN. Silver, G. L. U. S. Patent 3,726,956. 10 Apr 1973. Filed date 23 Feb 1972. 6p.

A method is presented for dissolving tungsten or molybdenum materials such as molybdenum coatings from fissionable materials such as nuclear fuel ceramic particles by contacting the molybdenum with sodium hypochlorite (NaClO) solution until desired dissolution is generally complete. (auth)

8044 URANIUM–PLUTONIUM PARTITION IN PUREX PROCESS WITHOUT THE PRESENCE OF REDUCING OR COMPLEXING AGENTS. Ortega, J.; Rusheed, A. (Junta Energia Nuclear, Madrid). An. Quim.; 69: No. 1, 117-122(Jan 1973).

Experiments to study the distribution coefficients of uranium and its separation in the first solvent extraction cycle, where large amounts of uranium are present, were carried out as a function of nitric acid, dibutyl phosphate (DBP), and uranium concentration. Data on uranyl nitrate distribution as a function of nitric acid concentration show that for 0.3 M nitric acid concentration and uranium concentration of less than 30 g/l the distribution coefficient is 1. In the presence of uranyl nitrate, the plutonium distribution coefficient is less sensitive to nitric acid effect and its value even with nitric acid concentration of 1.2 M does not exceed 0.25. When no uranium is present, the plutonium (IV) distribution coefficient is very sensitive to nitric acid and for a nitric acid concentration of 0.75 M the distribution coefficient is higher than 1. It was also shown that DBP does not affect the uranium partition when its concentration is below 10^{-3} M. (DHM)

8045 METHOD FOR THE REPROCESSING OF SPENT FUELS AND DEVICE FOR CARRYING OUT THE METHOD. German Patent 1,542,175. 4 Jun 1970. Filed date 28 Feb 1966. 18p. (In German).

A method is described for the reprocessing and purification of spent fuel elements in which the spent fuel is first dissolved and then the material is obtained by extraction from the solution. The fuel, in pulverized or preferably milled form, is dissolved in a continuously operating dissolver and the material in solution is continuously separated in an extraction column. The dissolver consists of a sealed rotating container which is provided with feed lines for the solvent and the material to be dissolved and with a delivery pipe for the solution. There are mixing and/or stirring devices in the rotating container. It is provided with a transport device for the transport of the material to be dissolved in countercurrent to the solvent. The inlet and discharge pipes are arranged on the same front wall of the container. The rotating container has rotating blades for emptying it. The device has two coaxial cylindrical containers rotating in opposite direction and have a transport screw. The transport screws are made of a material with high neutron absorption capacity. The device is provided with at least one mixer centrifuge. The characteristics of the mixer centrifuge are given. (JSR)

8046 METHOD FOR THE PROCESSING OF CARBON-CONTAINING OR GRAPHITE-CONTAINING RADIOACTIVE MATERIAL. Hoerbe, R. (to Kernforschungsanlage Juelich GmbH). German Patent 1,806,304. 14 May 1970. Filed date 31 Oct 1968. 12p. (In German).

A method for the processing of carbon-containing or graphite-containing irradiated material, especially of irradiated fuel and breeder material dispersed in graphite, is described. For the separation of the mineral constituent of the carbon or graphite, the carbon or graphite is burned at temperatures between 300 and 1300°C by introduction of oxygen and/or oxygen-containing gases. For separation of the carbon dioxide from the usual off-gas constituents, the off-gas is led by means of a washing device through a wash liquid dissolving the carbon dioxide. The radioactive rare gases contained in the remaining part of the off-gas are absorbed with a low-temperature absorber and decontaminated. The carbon dioxide is released by heating and/or pressure reduction in a regenerator of the wash liquid. A weakly alkaline solution, such as a solution of potassium carbonate, is used as the carbon dioxide dissolving liquid. The wash liquid after absorption of the carbon dioxide is led through the rinsing device connected to one of the washing devices and scavenged of a part of the off-gas from the combustion. The wash liquid provided for in the rinsing device is scavenged of a part of the carbon dioxide released in the regeneration of the wash liquid. A part of the off-gas obtained in the combustion is put back through the combustion area. The heat originating in the combustion is led by heat exchangers to the regenerator for the heating of the liquid of the regenerator. (JSR)

8047 CRYOGENIC RARE GAS RECOVERY IN NUCLEAR FUEL REPROCESSING. Bendixen, C. L.; Offutt, G. F.; Wheeler, B. R. (Allied Chemical Corp., Idaho Fall, ID). Chem. Eng. (N.Y.); 78: No. 22, 55-57(4 Oct 1971).

A continuous distillation process is described for the recovery of high-purity Xe and Kr in bottled form from HNO_3 solutions of irradiated Al-clad fuel. Effluent gases are passed from storage tanks over a Rh catalyst at 1000°F where N_2O is reduced to N and H is oxidized to H_2O. After removal of H_2O, oxides of N, and NH_3, effluents from the Rh catalytic-reduction unit enter the cryogenic system, which consists of 2 generators, a distillation unit, and a batch still with a feed rate of 20 to 30 std. ft^3/min. Liquid nitrogen introduced into the top of the column condenses and absorbs O, Xe, Kr, and Ar. Rare gases are allowed to accumulate until there is sufficient volume for a distillation run. (JGB)

8048 METHOD FOR THE PROCESSING OF IRRADIATED THORIUM CONTAINING FUEL OR BREEDER MATERIAL. Merz, E.; Laser, M.; Fischer, E.; Thomas, R.; Krabe, J. (to Kernforschungsanlage Juelich GmbH). German Patent 1,806,077. 2 Jul 1970. Filed date 30 Oct 1968. 16p. (In German).

A method is described for the processing of irradiated thorium-containing fuel and/or breeder material (such as the oxide or carbide of U or Th or similar material) dispersed in graphite or silicon carbide, or clad with graphite, or coated with pyrolytic carbon and/or silicon carbide. The fuel and/or breeder material, crushed by usual methods, was converted at 900 to 1200°C into gaseous chlorides by the normal methods. The chlorides were precipitated fractionally and the uranium fraction together with protactinium was dissolved in water or hydrochloric acid and extracted with long-chained tertiary amines. (JSR)

ENGINEERING

Energy Conversion

Refer also to abstracts 8107, 8622, 8740, 9757, 9796, 10098, and 10126.

8049 (AD-751632) COMPUTER MODELING OF SPACE CHARGE FLOW IN AN ELECTROGASDYNAMIC GENERATOR. Bohley, C. M. (Naval Postgraduate School, Monterey, Calif.). Jun 1972. 85p. NTIS.

Thesis.

In an electrogasdynamic (EGD) generator the flow of a neutral medium, carrying unipolar electrical charges, constitutes an electrical current. A model of the charge flow in an EGD generator was constructed for use in a computer program. The program is designed to solve Poisson's and Laplace's equations for both axisymmetric and two-dimensional geometries. Schlieren photographs of the charge cloud were used to determine the charge cloud profile required by the program. Computer generated predictions agreed with three known solutions to Poisson's equation. Computer predictions of the effects of space charge flow modifications were obtained. Space charge flow was modified both by increasing flow speed and by manipulating the space charge electric field. Experimentally, this was accomplished by increasing flow stagnation pressure and by application of a separate controllable electric field. Experimental results compare favorably with computer predictions. Some measurements were also made of the mobility range of the charged particles. (auth)

8050 (AD-755834) OPERATIONAL CHARACTERISTICS OF THE BETA-1 AND BETA-2 ISOTOPIC THERMOELECTRIC GENERATORS. Fradkin, G. M., Kodyukov, V. M.; Ragozinski, A. I.; Korotkov, N. P.; Kazakov, E. A. Jan 1973. Translation of Russian article. (FSTC-HT-23-1044-72). 10p. NTIS

The Beta-1 and Beta-2 experimental isotopic electrical generators, used as power sources for the ARMS-N Automatic Radio Meteorological Station, were created to check out a number of theoretical premises and design features upon which they are based. The Beta-1 and Beta-2 isotopic thermoelectric generators consist of the following basic components: isotopic and thermal units, a thermopile unit, the housing, a biological safeguard, a thermodischarge system, as well as the generation and storage of electrical energy. The experimental operation of the Beta-2 isotopic thermoelectric generator showed that the installation was reliable in its operation and that the design of the generator and the biological safeguard provide the necessary radiation safety-observing the widely accepted rules for operating the covered ion-emission sources and the rules for operation. (auth)

8051 (AD-755892) PRODUCTION OF HIGH-DENSITY UNIFORM PLASMAS FOR ADVANCED MHD GENERATOR AND ELECTRIC LASER DESIGN. Annual Progress Report for Period Ending 30 November 1972. Patrick, R. M. (Avco-Everett Research Lab., Everett, Mass). 30 Nov 1972. Contract F44620-70-C-0023. 33p. (AFOSR-TR-73-278). NTIS

The use of an electron beam to produce a non-self-sustaining electric discharge has been applied to a number of different gases. Electron loss rate processes have been measured in N_2, He, and CO, as well as mixtures of He, N_2 and CO_2. The addition of H_2O vapor to these gases has resulted in a new type of discharge instability which has not been previously observed. This instability is expected to exist under certain conditions in any preionized gas discharge in which electrons are lost predominantly by electron-neutral dissociative attachment, or by any process whose cross section is an increasing function of electron energy. It has been observed in pure CO_2 and He-CO_2 electron beam discharges. Theoretical understanding of this instability is important in possible applications of the electron beam discharge to MHD generators, MHD lasers and high-power gas lasers. (auth)

8052 (GULF-GA-A-11090) ISOTEC TECHNOLOGY PROGRAM. Annual Summary Report for the Period July 1, 1970–June 30, 1971. Elsner, N.; Rovner, L.; Staley, G.; Mautz, C.; Leedy, R. (Gulf General Atomic Co., San Diego, Calif). 26 Jan 1973. Contract AT(29-2) 2564. 86p. Dep. NTIS $3.00.

Research during July 1970 to July 1971 on the design, fabrication, and performance of thermocouple elements is reported. The materials investigated were: n-type PbTe; p-type PbSnMnTe; TAGS, a p-type material of $(GeTe)_{.85}(AgSbTe_2)_{.15}$; SiGe; and SbTe-GeTe alloys. Results obtained in element fabrication with the "warm vacuum pressing" plus the "Cat-in-Hat" bond between elements and caps indicate that the elements produced are stronger and more uniform than those pressed at room temperature in entrapped air and the bond is an improvement over the mechanical and metallurgical bond. (LCL)

8053 (N-73-16639) CORRELATION OF EXPERIMENTAL PERFORMANCE DATA FOR A CVD TUNGSTEN–NIOBIUM, PLANAR THERMIONIC CONVERTER. Sockol, P. M. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Feb 1973. 14p. (NASA-TM-X-2716; E-7194). NTIS.

Approximate expressions are presented which correlate experimental performance data from a CVD tungsten–niobium, planar thermionic converter. The current voltage characteristics are given as functions of emitter and collector temperatures and cesium pressure for currents below the knee in the ignited mode. The correlation covers the temperature ranges of 1700 to 1950°K for the emitter, 900 to 1050°K for the collector, and 580 to 645°K for the cesium reservoir. (auth)

8054 (UCRL-51373) PLASMA EXPANDER FOR VENETIAN BLIND DIRECT CONVERTERS. Smith, R. R. (California Univ., Livermore. Lawrence Livermore Lab). 6 Apr 1973. Contract W-7405-eng-48. 11p. Dep. NTIS $4.00.

Characteristics and advantages of a plasma expander with a field simulating that of a magnetic monopole were investigated. Such a field, with $B \alpha 1/r^2$, exactly conserves an ion's magnetic moment. The expander is especially suitable for a "Venetian Blind" direct recovery unit. A monopole field can be approximated with coils arranged on the surface of a 30° cone, except at the apex and base of the cone. (auth)

8055 EFFECT OF MULTISTAGE FEEDING OF A COLD LIQUID ON EFFICIENCY OF AN INJECTOR-TYPE MAGNETOHYDRODYNAMIC CYCLE. Morozov, A. E.; Shpil'rain, E. E. (High Temperature Inst., Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 974-979(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 1090-1096 (1972).

The qualitative effect of the multistage feeding of a cold liquid on the efficiency of an injector-type magnetohydrodynamic cycle is discussed. It is shown that the use of a multistage injector can lead either to an increase or to a decrease in the effective efficiency. In addition, the conclusion is also drawn that the introduction of a multistage injector into an optimal single-stage cycle is always advantageous from the point of view of an increase in its efficiency. (auth)

8056 CHOICE OF THE PARAMETERS OF A PEAKING MAGNETOHYDRODYNAMIC UNIT. Ivanov, P. P.; Kovbasyuk, V. I.; Koryagina, G. M.; Rogachev, A. P. (High Temperature Inst., Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 980-984 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 1097-1101 (1972).

Simplified units with magnetohydrodynamic generators (magnetohydrodynamic electric power plants), for spanning the variable part of the graphs of the electrical load, are proposed. The oxidizer for the fuel may be either air enriched with oxygen or oxygen stored using a continuous oxygen unit. A method for choosing the optimal parameters of peaking magnetohydrodynamic electric power plants, using the criterion of a minimum value of the specific calculated expenditures, is discussed. The special characteristics of flow in the channel of a peaking magnetohydrodynamic generator are discussed. The change in the structure of the specific calculated expenditures for a peaking magnetohydrodynamic unit is investigated as a function of the number of hours per year during which it operates. Dependences of the specific calculated expenditures for a peaking magnetohydrodynamic electric power plant are obtained as a function of the length of the channel for different concentrations of oxygen, time of operation of the unit, and cost of the fuel. The best technical and economic indices are those of a peaking magnetohydrodynamic electric power plant with combustion of the fuel in oxygen. The article discusses means for improving the technical and economic indices of peaking magnetohydrodynamic electric power plants. (auth)

8057 ARRANGEMENT FOR THE REDUCTION OF THE LOSS IN LINEAR INDUCTIVE MHD CONVERTERS OCCURRING AS A RESULT OF THE END EFFECT. Andresen, E. (to Licentia Patent Verwaltungs Gmbh). German Patent 1,813,279. 25 Jun 1970. Filed date 4 Dec 1968. 8p. (In German).

An arrangement, using an exciter and compensation windings, for the significant χ suppression of the loss occurring in linear inductive MHD converters because of the finite length is described.

Exciter and compensation windings, which were traversed by phase-displaced alternating current, were attached to the converter ends. The exciter windings are provided for the excitation of the unipolar air gap current and the compensation windings for compensation of the unipolar magnet yoke current. The current flowing through the exciter and compensation windings are phase-displaced electrically 90° from each other. The exciter windings are arranged in a plane parallel to the plane of the flow channel. The exciter windings are wound around the converter parallel to the plane of the flow channel. The compensation windings are arranged in a plane parallel to the face. The exciter and compensation windings are constructed as annular coils which surround the flow channel at the converter ends. The exciter and compensation windings are designed as low-temperature or superconducting windings. The faces of the converter are arranged at an angle to the flow channel. The faces are arched. (JSR)

8058 MAGNETOHYDRODYNAMIC METHOD FOR THE TRANSFORMATION OF THERMODYNAMIC ENERGY INTO ELECTRICAL ALTERNATING CURRENT OR THE REVERSE AND DEVICE FOR THE CARRYING OUT OF THIS METHOD. Bidard, R. (to Compagnie Electro Mechanique). German Patent 1,959,458. 11 Jun 1970. Filed date 26 Nov 1969. 21p. (In German).

A magnetohydrodynamic method for the transformation of thermodynamic energy from a flowing working medium into electrical ac energy is described. In the method, an electrically conducting liquid flows in a closed circuit through at least one ring or loop channel. The channel is completely within a magnetic field. The liquid also flows through a generator area in which the liquid is mixed with gas and through a consumption area in which the pressure of the liquid separated again from the gas was increased. A quadrupole alternating field was used as the magnetic field. Its slippage with respect to the working medium in the generator range, which consists of a gas–liquid mixture, is positive as in an asynchronous generator and is negative in the consumption range as in an asynchronous motor. The mixture expands in the generator range and the liquid is compressed in the consumption range. The device consists of at least one ring or loop channel in which a conducting liquid flows in a closed circuit. The two opposed electrically insulating walls, which are perpendicular to the magnetic field and the two opposed walls which are parallel to the magnetic field are electrically conducting and form short-circuiting rings for the conducting liquid. The device has both a generator and a consumption range, which are separated by two intermediate areas connecting these ranges. The intermediate range placed in the flow direction of the liquid before the generator range contains a mixing device for the dispersion of a gas in the liquid. The other intermediate range has a separation device for removal of the gas from the liquid. There is an arrangement for the production of slipping multipolar magnetic field along the entire loop. The cross section of the loop is so selected that the tangential velocity of the flow in the generator range is larger and in the consumption range smaller than the migration velocity of the magnetic field. (JSR)

8059 ANNUAL THERMIONIC CONVERSION SPECIALIST CONFERENCE. Tenth conference held at San Diego, California, October 4–6, 1971. New York; Institute of Electrical and Electronics Engineers, Inc. (1971). 349p. (CONF-711038-). $20.00.

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971).

Forty-three papers were presented at the conference. A separate abstract was prepared for each of 41 papers. Two papers have been previously included in NSA. For abstracts of these see Abstracts 26: 18121 and 26: 18379. (RCK)

For abstracts of individual papers see: 8060–8076, 8573–8575, 8693, 8694, 9796, and 10108–10125.

8060 DETAILED DESIGN OF A 100-We MULTICELL THERMIONIC POWER SUPPLY. Rouklove, P. (California Inst. of Tech., Pasadena); DeSteese, J. G. pp 59-67 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

The general trends of a parametric study of PuO_2-fueled thermionic generators in a detailed 100-W(e) generator design are described. The detailed design takes into account the additional weight of system-integration components and shows that design refinements of all aeroshell components are possible when a specific generator configuration is considered. An optimized 100-W(e) thermionic power supply design is presented, reflecting a 0.98 reliability goal after five years of operation. The optimum multicell array consists of 28 Isomate converters, each producing approximately 3.6 W(e) at end-of-life. The optimum arrangement of converters in the aeroshell is a four-column, seven-row stacking configuration connected electrically as a two-column, 14-row array. (auth)

8061 DEXTER: A ONE-DIMENSIONAL CODE FOR CALCULATING THERMIONIC PERFORMANCE OF LONG CONVERTERS. Sawyer, C. D. (California Inst. of Tech., Pasadena). pp 92-98 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

A versatile code for computing the coupled thermionic electric-thermal performance of long thermionic converters in which the temperature and voltage variations cannot be neglected is described. The code is capable of accounting for a variety of external electrical connection schemes, coolant flow paths and converter failures by partial shorting. Example problem solutions are given. (auth)

8062 OXYGEN AND THE CESIUM THERMIONIC CONVERTER. Warner, C. (North American Rockwell Corp., Canoga Park, CA). pp 170-180 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

The investigation of the cesium–oxygen–tungsten electrode system with a statistical mechanical model is described. The experimental data of Alleau and Bacal (1970) were used for comparison. Two operational regions were recognized as the 2- to 5-eV emitter-like work function region and the very low collector-type work function region. The above model describes the emitter-type region qualitatively. For the low collector-type work function region, a different approach was used based on the many-electron formalism of Hohenberg and Kohn (1964) and initially used by Smith (1969) to evaluate work functions. The cesium–tungsten system was initially studied. A work function minimum is found, and the electron density results are presented in a fashion which strongly suggests that the mathematical approach can be simplified. Finally, an intermediate oxygen layer whose function is to localize electrons was added. No essential work function change resulted, and it is suggested that the neglected polarization of this fixed charge is responsible for the oxygen effect. (auth)

8063 FORMATION OF METAL-OXYGEN COMPOUNDS FOR ADDITIVE THERMIONIC CONVERTERS. Lieb, D. (Thermo Electron Corp., Waltham, MA); Rufeh, F.; Stahlkopf, K.; Pigford, T. AT(30-1)-4125. pp 194-198 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

The apparatus and preliminary results of an experimental study of metal oxide formation in vacuum are described. The study was performed for the purpose of determining whether oxides can form in thermionic diodes during outgassing and affect the diode performance by providing sources of oxygen for the emitter through thermal decomposition of the oxide at the collector or the emitter surface. The results indicate that oxide can be formed on the collector which can be made to influence the emitter work function. (IAA)

8064 THERMIONIC ENERGY CONVERSION WITH A Ba–Cs-DIODE. Henne, R. (Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt eV, Stuttgart). pp 212-219 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

The program of the Thermionic-group in Stuttgart is discussed. Experiments with Ba–Cs-diodes and some important problems involved in the use of barium and their solutions in our laboratory are described. Results obtained with a plane Ba–Cs thermionic converter with polycrystalline molybdenum electrodes with variable spacing and the conclusions for future works are represented. (auth)

8065 OUTPUT PERFORMANCE OF A THERMIONIC CONVERTER WITH AN ORIENTED TUNGSTEN (110) EMITTER AND A POLYCRYSTALLINE TUNGSTEN COLLECTOR. Wilson, V. C. (General Electric Co., Schenectady, NY). Contract AT(04-3)-771. pp 220-224 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Measurements were made of the power generated by a parallel plane thermionic converter with an oriented tungsten (110) emitter and a polycrystalline tungsten collector. The emitter had a vacuum work function of 5.06 eV. Curves have been made to compare the output of this converter with that of converters with identical

emitters but collectors of Nb and Ni. With emitter temperatures from 1750 to 2150°K the converter with the W collector averaged about 8% more output power than the converter with the Nb collector. However, the converter with the Ni collector produced about 17% more power than the converter with the Nb collector. (auth)

8066 COMPARISON OF COMPUTER-ACQUIRED PERFORMANCE DATA FROM SEVERAL FIXED SPACED PLANAR DIODES. Manista, E. J.; Smith, A. L.; Lancashire, R. B. (Lewis Research Center, Cleveland). pp 225-230 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Performance data are compared for thermionic diodes with various tungsten or rhenium emitters and niobium or molybdenum collectors. The planar converters have guard-ringed collectors and a fixed space of 10 mils (0.254 mm). The data were acquired using a computer. The parameters are the temperatures of the emitter Te, collector Tc, and cesium reservoir Tr. The composite plots have constant Te and varying Tc or Tr or both. The envelope and composite plots having constant Te are presented. The diodes were tested at increments between 1500 and 2000°K for the emitters, 750 and 1100°K for the collectors, and 520 and 650°K for the reservoirs. (auth)

8067 CYLINDRICAL DIODE CHARACTERISTICS WITH SUBLIMED ELECTRODE SURFACES. Dunlay, J.; Matsuda, S.; Poirier, V. (Thermo Electron Corp., Waltham, MA). Contract AT(30-1)-4125. pp 242-247 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038 -.

The fabrication and testing of a cylindrical diode with sublimed electrode surfaces is described. Electrode surface preparations are presented together with the results of chemical and metallurgical analysis of sample coatings. Diode test results are compared with data from preferred oriented electrodes and additive diodes. (auth)

8068 OUT-OF-CORE EVALUATIONS OF A NONFUELED AND A UO_2 FUELED CYLINDRICAL THERMIONIC CONVERTER. Shimada, K. (California Inst. of Tech., Pasadena). pp 248-252 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038 -.

Two cylindrical thermionic energy converters similar to those in a flashlight thermionic fuel element were tested electrically at the Jet Propulsion Laboratory. One converter was not fueled, but the other was fueled with UO_2 imbedded in six pencil-lead-size holes in the emitter, which was made of rhenium. The nonfueled converter showed no change in its performance during 4000 h of testing, whereas the output current of the UO_2-fueled converter degraded 15% during 2400 h of testing at 2000°K. Measurements on the UO_2-fueled converter showed an increase in the collector work function and an increase in the bare emitter work function. The degradation appears to be caused primarily by foreign deposits on the collector, probably uranium that diffused from the UO_2 fuel through the emitter. (auth)

8069 EVALUATIONS OF URANIUM-NITRIDE FUELED CONVERTERS. Shimada, K.; Cassell, P. L. (California Inst. of Tech., Pasadena). pp 253-257 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038 -.

Evaluation of two uranium nitride (UN) fueled converters was initiated at the Jet Propulsion Laboratory to investigate the effect of fuel on the converter performance while being operated out-of-core. The initial tests were performed with the dynamic data acquisition system that was developed at the Laboratory. Parametric tests of these converters were to obtain: (1) static volt-ampere curves, (2) dynamic volt-ampere curves, and (3) the electrode work functions. The power outputs were 9.3 W/cm^2 for the rhenium converter and 3.8 W/cm^2 for the tungsten converter at 0.6 V when the emitter surface temperature was 2000°K, according to the static volt-ampere curves. (auth)

8070 PARAMETRIC OPTIMIZATION OF A CYLINDRICAL CONVERTER WITH A MOLYBDENUM EMITTER AND NIOBIUM COLLECTOR. Haar, W. (Brown, Boveri et Cie AG, Mannheim, Ger.); Holick, H. pp 258-263 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038

The performance of a cylindrical thermionic converter with a Mo emitter and a Nb -1% Zr collector was studied parametrically in the laboratory by varying the operating temperatures. The emitter was heated by a centrally located electron bombardment heater. Current-voltage characteristics were obtained by changing the driving voltage for a given set of converter temperatures. Current-voltage curves for optimized cesium and collector temperatures were obtained at 50°C emitter temperature intervals. The output power density was found to be rather insensitive to the collector temperature in the vicinity of the output power maximum. The optimum output power density and efficiency increased from 0.8 W/cm^2 and 3.4% respectively at 1550°K to 6.5 W/cm^2 and 12% at 2000°K emitter temperature. (auth)

8071 INFLUENCE OF THE ELECTRON TEMPERATURE AND OTHER PARAMETERS ON THE ELECTRON DENSITY OF A CESIUM PLASMA IN A THERMIONIC CONVERTER. Froehlich, G.; Sewing, K. H. (Univ., Stuttgart). pp 264-270 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038 -.

Calculated electron densities are compared with experimentally measured densities. By modifying the Maxwellian distribution for the high energetic electrons (a reduction of the "Maxwellian tail") theoretical calculations show a good agreement with measured electron densities for various current densities. The temperature variation of the lower energetic electrons is also discussed and is followed by a deterministic study of the effect of deviations in the converter parameters. The pressure, electrode spacing, emitter and collector temperature were decreased by 10% of their operating values. (auth)

8072 SUPPRESSION OF ARC DROP IN THERMIONIC CONVERTERS. Rasor, N. S.; Britt, E. J. pp 272-281 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038 -.

The results of the first phase of an experimental program that is to explore various methods of suppressing the arc drop in thermionic converters are described. In this first phase, argon discharge was used as an analog of cesium discharge, and the optimized methods for the argon arc were applied to a cesium vapor converter. Experiments with cesium diodes indicate that the containment of ions and an enhanced output are achievable in a cesium discharge converter. (IAA)

8073 COMPUTED PERFORMANCE DATA FOR A THERMIONIC CONVERTER HAVING A Cl-CVD-W EMITTER AND A POLYCRYSTALLINE Nb COLLECTOR. McCandless, R. J.; Wilkins, D. R. (General Electric Co., Cincinnati). pp 282-287 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038 -.

Results of calibration of the SIMCON computer program to current-voltage data taken by Wilson and Podkulski (1970) on a thermionic converter with a chloride vapor-deposited tungsten emitter and niobium collector. The computed and measured current-voltage characteristics show excellent agreement over a wide range of converter operating points. A large data map has been generated with the newly calibrated SIMCON program for T_E = 1600 to 2200°K, T_C = 800 to 1200°K, T_R = 540 to 640°K, d = 10 to 15 mils, and J = 0 to 35 A/cm^2 (or if more limiting, for V greater than 2.0 V). The computed data are plotted in the form of current-voltage and current-charged particle cooling curves. Computed data also include cesium heat conduction, radiation heat transfer, converter thermal power, and converter efficiency. A simple charged-particle cooling recipe shows excellent agreement with the more sophisticated SIMCON representation in the positive-power quadrant. (auth)

8074 LIMITATIONS OF THE BASIC ASSUMPTIONS IN CESIUM ARC MODE THEORY. Claassen, H. A. (Kernforschungsanlage, Juelich, Ger.). pp 300-307 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Considering the range of external diode parameters, in which mean free paths are small enough to justify the use of transport equations, the assumptions underlying the calculations of rate coefficients in the particle and energy balance equations are examined. Diagrams are presented, which, on the basis of exist-

ing approximations to the relevant cross sections, allow one to judge the applicability of these assumptions. (auth)

8075 POST IRRADIATION EXAMINATION OF A UO_2-FUELED THERMIONIC DIODE WITH A REVOLVER TYPE EMITTER. Zoeller, R. (Brown, Boveri et Cie AG, Mannheim, Ger.); Jester, A. pp 323-329 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038-.

Description of postirradiation investigations of a UO_2-fueled thermionic converter, recently tested in the FR2 reactor of the Nuclear Research Center Karlsruhe. The test duration covered 3150 h. The emitter temperature was kept at 1900°K, resulting in a power density of 4 to 5 W/cm^2. The emitter was of the vented type; the fission gases were continuously pumped by an ion getter pump. The end of the test was due to a swelling of the emitter, followed by a short to the collector. A polar dimension control showed a rippled surface structure corresponding to the 10 fuel bore holes. Further analysis indicates that this surface ripple was most likely caused by thermal stresses rather than by fuel swelling. In spite of venting, the fission gas retention rate in the fuel was found to be very high for the operating temperature (2000°K), about 70%. The release of only 30% was confirmed by examination of the ion getter pump. (auth)

8076 CYTHERE EXPERIMENT: DESCRIPTION OF THE DEVICE AND PRELIMINARY RESULTS. Kauffmann, Y.; Durand, J. P.; Stora, J. P.; Francois, B. (CEN, Grenoble, France). pp 330-335 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038-.

A device is described which was used to test experimental fuel elements under geometrical and thermal conditions close to those expected in thermionic converters. The device makes it possible to irradiate either two sealed elements, or one 300-W(e) type emitter connected with a fission gas recovery apparatus. The surface temperature of the emitter, heated by nuclear effect only, is kept constant by adjusting the pressure of a twin helium gap, in the range from 10 to 100 torr. Two fuel elements composed of a molybdenum sheath fueled with a UO_2 60 vol % Mo dense cermet have been irradiated at 1700 and 1350°C, respectively, as a preliminary experiment. The irradiation was stopped at a burnup of about 3×10 to the 19th fissions per cm^3 of cermet, when fission gases were detected in the helium gaps. A neutrographic examination showed that the fuel of the hotter element swelled by about 30% in volume, while no deformation of the fuel irradiated at the lower temperature was noticed. (auth)

8077 CONSTRUCTION PRINCIPLE OF A THERMIONIC LONG LIFE CONVERTER USING BARIUM AND CESIUM VAPORS. Knauss, G. Stuttgart; Univ. Stuttgart (1971). 71p. (In German).

Thesis.

A construction method is suggested in which the continuous condensation of barium vapor takes place prior to the enrichment of the ceramic at a temperature of about 520°K. Thus, barium does not touch the oxide ceramic. The principle of this construction was shown to function and to give useful results by a diode with plane parallel electrodes. The initial electric power had a maximum value of 7 W/cm^2 at 0.8 V initial voltage and at 1,950°K emitting temperature. (GE)

8078 ASSESSMENT OF SOLAR ENERGY AS A NATIONAL ENERGY RESOURCE. College Park, MD; University of Maryland (1972). 88p.

The Solar Energy Panel, organized in Jan. 1972, was comprised of nearly 40 scientists and engineers as well as several economists, environmentalists, and sociologists. The Panel was charged with assessing the potential of solar energy as a national energy resource and the state of the technology in the various solar energy application areas, and with recommending necessary research and development programs to develop the potential in those areas considered important. The scope of the Panel's activities was defined to include all applications of direct solar energy, as well as power from wind, ocean thermal differences, and useful energy from replenishable organic materials. The following information is tabulated to facilitate an overview of the Solar Energy Panel's findings: status of solar utilization techniques; summary of major technical problems; impact of solar energy applications on the reference energy system; and summary of overall program funding. Based on these findings the Panel recommended that: the Federal Government take a lead role in developing a research and development program for the practical application of solar energy to the heat and power needs of the U.S.; the solar energy R&D program provide for simultaneous effort on the three main objectives of economical systems for heating and cooling of buildings, economical systems for producing and converting organic materials to liquid, solid, and gaseous fuels or to energy directly, and economical systems for generating electricity; research and development proceed on various methods for accomplishing the above objectives and that programs with phased decision points be established for concept appraisal and choice of options at the appropriate times; for those developments which show good technical and economic promise, the Federal Government and industry continue development, pilot plant, and demonstration programs; and environmental, social, and political consequences of solar energy utilization be continually appraised and the results employed in development program planning. (LCL)

8079 COMPUTED EFFICIENCIES OF A DIRECT-CONVERSION COLLECTOR FOR A FUSION REACTOR. Freis, R. P. (Univ. of California, Livermore). Nucl. Fusion; 13: No. 2, 247-257(Mar 1973).

By numerical simulation, the efficiency of a system to recover the energy carried away from a fusion reactor by the charged particles escaping through the magnetic mirrors is calculated. A beam of particles injected into a 2N collector electrostatic field configuration proposed by Post is studied, and the effect of varying the collector parameters (number of collector fins 2N, fin spacing, and electric field strength) as well as beam parameters (beam width, energy spread, and density at the entrance) is determined. It was found that, for 2N ranging from 12 to 36, the optimum efficiency in the limit of low density, $\overline{\eta}_{T0}$, ranges from 0.82 to 0.88, respectively, for a beam with a factor of 2 in energy spread. Increasing the energy spread to a factor of 4, more typical of a reactor situation, decreased $\overline{\eta}_{T0}$ from 0.84 to 0.76 in the 24-fin system. The 36-fin system can tolerate a maximum beam density greater by a factor of 2 than that for a 12-fin system. For a 24-fin system of reactor dimensions and energies this produces beam densities of 2.5×10^6 particles/cm^3 or, equivalently, 2.8 MW/m^2. (auth)

8080 NUCLEAR POWERED IMPLANTABLE HEART PACEMAKERS. Schaldach, M.; Thull, R.; Blaser, R. (Erlangen Nuernberg Univ., Erlangen, Ger.). Atomkernenergie; 21: No. 1, 17-26(1973). (In German).

From joint annual meeting of the German Society for Biophysics and the German Society for Medical Physics; Erlangen, Germany (4 Oct 1972).

Efforts for extending the operational life of implantable pacemakers are made by utilizing biological fuel cells and biogalvanic elements as well as nuclear batteries. In so-called isotope batteries presently released in experimental and clinical evaluations, the radiation energy released by the decay of radioisotopes is converted either directly or indirectly into electrical energy. The current developments are summarized including a description of various models which are in clinical evaluation. It is generally accepted that only long-term trials can show whether the application of nuclear powered pacemakers can come up to expectations with respect to increased operational life. (GE)

Facilities and Equipment

Refer also to abstracts 7945, 8120, and 8150.

8081 (NYO-4117-10) DEVELOPMENT OF HIGH TEMPERATURE ROLLING BEARINGS FOR OPERATION IN LIQUID SODIUM. Quarterly Progress Report No. 8, July 1, 1972-September 30, 1972. Jamison, W. E. (SKF Industries, Inc., King of Prussia, Pa. Research Lab.). 1972. Contract AT(11-1)-3061. 20p. AT $4.00.

Five ball bearing tests were conducted during this reporting period, utilizing bearing elements of powder processed NM100 tool steel. The first three tests were run with TZM cages while the last two tests utilized silver plated 4340 steel cages. A total of 32 h of testing time was accumulated with these five bearings in liquid sodium at temperatures of 600 and 800°F, at applied axial loads of up to 500 lb and at speeds of 500 rpm and 1000 rpm. The test procedures and results are described in detail. (TFD)

8082 (RDT-F-9-1-T(4-73)) REQUIREMENTS FOR NUCLEAR COMPONENTS AT ELEVATED TEMPERATURES (SUPPLEMENT TO ASME ELEVATED TEMPERATURE CODE CASE 1331). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1973. 45p. RSO.

This standard supplements the rules of ASME Code Cases 1331-5, 1331-6 and 1331-7 for the construction of Class 1 nuclear components, parts and appurtenances for high temperature service and constitutes the sole means for the application of Code Case

1331 to the design, fabrication and installation of such equipment in facilities under RDT cognizance. This standard is a complete set of requirements only when used in conjunction with ASME Code Case 1331, Section III of the ASME Boiler and Pressure Vessel Code, including Addenda, and RDT standard E 15-2. Instructions on analytical methods to be used with this standard are provided and include: inelastic (elastic-plastic-creep) analysis requirements; material data to be obtained from the Liquid Metal Fast Breeder Reactor Materials Handbook; guidelines on methods for design analysis; and computer programs for elastic and inelastic analysis. (LCL)

8083 METHOD AND DEVICE FOR CUTTING THROUGH REACTOR FUEL ELEMENT JACKETS, IRRADIATION CAPSULES, OR STORAGE TANKS AND TRANSPORT CONTAINERS BY MEANS OF HIGH FREQUENCY. Dorner, S.; Schretzmann, K.; Reiss, F. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,589,815. 14 May 1970. Filed date 3 Mar 1967. 9p. (In German).

A method is described for the contactless cutting of thin-walled reactor fuel element jackets, irradiation capsules, storage tanks, and transport containers of electrically conducting material in vacuum, high vacuum, or at high pressure. The object to be cut is brought by remote control to a high-frequency coil contactless at the cutting site. The high-frequency circuit is activated until the cutting site is melted and the two sections are moved apart. In the case of non-conducting material an electrically conducting ring is wound around the cutting site. In the case of hollow containers a pressure difference is produced between the external and internal area before or during the heating. For separation of the molten cutting sites, half of the object is weighted. The cutting site of the object is exposed to the effect of a mechanical oscillation field. For carrying out this method an electrically non-conducting collecting vessel is arranged between the induction coil and the separation site (in the case of objects of electrically conducting material) and between the induction coil and conducting rings (in electrically non-conducting objects). A concentrator is introduced between the induction coil and the object or ring. (JSR)

8084 CHAMBER FOR THE MICROMANIPULATION OF COATED PARTICLES. Brown, P. E.; Campbell, D.; Evans, J.; May, F. J. (Atomic Energy Research Establishment, Harwell, Eng.). Energ. Nucl. (Madrid); 16: No. 80, 645-660(1972). (In Spanish).

The characteristics of a special work chamber designed for the purpose of obtaining statistical information on the combustion and thermal behavior of fuel particles coated with pyrocarbon or silicon carbide for use in high temperature reactors are described. Some experimental results obtained after the irradiation of some samples in the DRAGON reactor are reported. (tr-auth)

8085 LIQUID METAL MONITORS. Roach, P. F.; Davidson, D. F. (to United Kingdom Atomic Energy Authority). British Patent 1,308,466. 28 Feb 1973. Filed date 7 Oct 1969. 5p.

A modification is described to the liquid metal monitor described in BP 1,085,633. This monitor comprises an orifice in the liquid metal flow path in which is maintained a partial plug of impurity precipitate by temperature control, thereby restricting flow through the orifice to a selected fraction of the unplugged flow. The temperature at the orifice, when the amount of partial plugging is stable, is indicative of the impurity content of the liquid metal. Means are provided at the orifice for dividing the liquid metal flow into two parts, one part passing through and the other part bypassing the orifice. In the modification described, heat transfer means are provided whereby heat energy is transferred from the liquid metal upstream of the orifice to that downstream of the orifice. Cooling means are provided for the liquid metal upstream of the orifice, together with heating means whereby liquid metal downstream can be re-heated. This system effects heat transfer between liquid metal in the monitor and a heat exchange medium in a separate fluid circuit including a cooler and a pump, with control means whereby the rate of pumping in the separate circuit is rendered dependent on the rate of flow of liquid metal through the orifice. The rate of pumping may be partly dependent on the temperature of the liquid metal in the region of the orifice, thereby creating a double servo loop control serving to reduce disturbances of the temperature reading due to change in liquid metal inlet temperature. Application may be to determine radioactive contamination in the liquid metal. (UK)

8086 DEVICE FOR THE PREPARATION OF THIN INSULATING LAYERS BY MEANS OF ION SPUTTERING. Fiedler, O.; Weissmantel, C.; Reisse, G. (to Institut fuer Elektronische Bauelemente). German Patent 1,934,327. 4 Jun 1970. Filed date 7 Jul 1969. 10p. (In German).

A device for the preparation of thin insulating layers by means of ion sputtering is described. The device consists of the combination of a standard ion sputtering system, preferably one with selective sputtering by the plasma or ion beam method, with one or more electron beam sources which are arranged in the immediate vicinity of the target, preferably in metallic contact with the cooled target holder. The electron beam source consists of a metallic housing with a cathode having one or more emission openings and of a diaphragm or diaphragm system installed on the housing. The openings of the cathode are preferably slits and are in the direction of the target. (JSR)

8087 NEUTRON IRRADIATOR PROVIDED WITH A DEVICE ENABLING THE IRRADIATOR TO BE TRANSPORTED WITH A REDUCED BIOLOGICAL SHIELDING. (to Establissements Lemer et Compagnie). French Patent 1,604,899. 17 Apr 1972. Filed Date 12 Dec 1968. 5p. (In French).

An irradiator, using a separator device, was developed in view of transporting the irradiator with reduced biological shielding. In a neutron irradiator utilizing the γ,n reaction, the biological shielding must be very extensive, because of the simultaneously emitted γ radiation and neutrons. Such shielding presents difficulties for transport and possible interventions with the apparatus. The neutron flux is produced by the action of γ rays emitted from a radioactive source on an envelope constructed of a material such as Be positioned in the immediate proximity of the source. The invention is based on the possibility of freely varying the distance between the source and the envelope. The separator device developed enabled a neutron irradiator to be conceived in the form of a central container provided with a biological shielding for only γ radiation and a complementary shielding fixed around the container when in use. (FR)

Heat Transfer and Fluid Flow

Refer also to abstracts 9969, 9970, 9997, 9998, 10016, 10017, and 10195.

8088 (EUR-5008) VAPOUR-BLANKET TRANSITION ZONE IN SIMPLE BOILING-METAL SYSTEMS. Schins, H. E. J.; Ooms, M. C. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00. Eur B. Fr. 25.-.

It was demonstrated that nucleate boiling of sodium in stagnant conditions cannot be termed stable boiling. The reason is that as a result of the big volume of the vapor bubbles a considerable amount of bulk liquid is continuously expelled from the pool. This liquid will gather in the condensation region and will flow down in a subcooled condition. The subcooled liquid sodium tracks cause important thermal stresses in the vessel walls and also preferential condensation of sodium vapor. Bulk expulsion and preferential condensation evidently cause major instabilities in the vapor column and disturbance of the vapor-blanket transition zone. If it is concluded that a stable vapor-blanket transition zone is characteristic for stable boiling, then the open heat-pipe, the thin film evaporator, and the transpiration evaporator are inherently stable. (auth)

8089 (GEAP-10151) TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES. Seventeenth Quarterly Progress Report, October 1–December 31, 1969. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept). Jan 1970. Contract AT(03-4)-189. 40p. Dep. NTIS $3.00.

Flow rate in the zone next to the wall in the circular tube test section was measured isokinetically; the quality was also determined. Results show that the mass velocity in the zone next to the wall (up to a zone thickness of 0.03 in.) generally increases with distance past the end of the heated length. The quality in the zone next to the wall is quite low (zero to 4½%), and nearly independent of the average channel quality in the range of channel qualities from 2 to 20%. (auth)

8090 (ORNL-TM-4123) MODEL FOR TWO-PHASE FLOW IN WATER. Clark, F. H. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 41p. Dep. NTIS $4.25.

A model for two-phase flow was developed to provide detailed dynamics of water flow in the core of a light-water reactor during blowdown. Further model development has been necessary to meet the enlarged problem scope resulting when nonequilibrium conditions are allowed between the two phases. Moreover, because of apparent disagreement in the textbook methods of representing some effects, a return to prior principles seems mandatory. Nine thermodynamic regions are defined according to whether there is one or two phases present and also to the relation that the enthalpy of each phase bears to its equilibrium value. Three of these regions are discarded because they have no bearing on problems of interest. A complete set of equations appropriate to each region is developed, different, in general, for each region. Appropriate region boundary conditions are devised (although there still remains a question about the correct enthalpy conditions at a

boundary between a two-phase and a one-phase region). Two kinds of interphase mass exchange are considered: that which is driven by heat or work input or pressure change, and that which arises from crossings of a phase boundary due to a statistical resolution of differences on the two sides. These are quite different effects, requiring different kinds of coefficients for their description. The formal structure of the model is one dimensional. Transverse flows and interphase transfers are handled through the conventional strategy of inhomogeneous terms. There is a wide difference of opinion in the literature concerning the treatment of pressure derivatives, the space derivative in the momentum equation, and the temporal derivative which appears when the energy equation is written in terms of enthalpy. One can find the temporal derivative in the same context given as a partial, a total, or a substantial derivative. This study indicates that in the formulation chosen the derivative should be partial. In the separate phase formulation, a factor α or $(1-\alpha)$ appears in each pressure derivative term, α being the local volume fraction of gas phase. This investigation indicates that the α and $(1-\alpha)$ terms should fall within the differential operator, although a number of workers treat it as a coefficient to the operator. (auth)

8091 (RD/B/M-2533) THERMODYNAMIC AND TRANSPORT PROPERTIES OF WATER AT ATMOSPHERIC PRESSURE IN A CONVENIENT FORM. Durham, M. E. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Jan 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

Those thermodynamic and transport properties of water needed for single-phase heat transfer calculations are presented in graphical form for a pressure of 1 atm. Analytic expressions are given, from which the value of the particular property may be found as a function of temperature. S. I. units are used throughout and conversion factors are provided for alternative systems of units. (auth)

8092 (TUBIK-26) COMPARATIVE COMPILATION OF RESULTS AND SOLUTIONS TO THERMAL-FLUIDDYNAMIC PROBLEMS IN ECCENTRIC ANNULI. Wolf, L. (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). Mar 1973. 104p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

Results of theoretical predictions and experimental investigations of momentum and energy transport in eccentric annuli are summarized and compared. The study of these problems in this special geometry seems to be of some practical interest in view of the more complicated channels such as finite rod bundles. Furthermore, from the theoretical point of view the eccentric annulus is a very interesting geometry because a lot of problems may be solved analytically using the bipolar coordinate system which fits the boundaries of the channel. Due to this orthogonal coordinate system it is possible to compare different methods of solution in extreme situations which has been done in this survey. The advantage of analytical methods in the case of laminar and slug flow problems is clearly shown and the use of orthogonal nets on the basis of the bipolar coordinate system in case of the turbulent flow problems is proposed. Additionally, results are given for an analytical procedure developed for a multiregional solution of the slug flow-heat transfer problem. These results may be quantitatively useful for the interpretation of liquid metal heat transfer studies in eccentric annuli to study the simulation behaviour of heat transfer equipment. Especially in this field, the knowledge of theoretical background seems to be necessary to limit the experimental efforts. The need is stressed for further theoretical as well as experimental investigation in this field because even the results for the momentum transport in this geometry show a lot of discrepancies as demonstrated by the remarkable differences in interpreting the secondary flow effects. It is believed that a better understanding of these effects may lead to a more accurate picture of the transport processes in finite rod bundles, too. (auth)

8093 DEVELOPMENT OF THERMAL TECHNIQUES IN THE NUCLEAR FIELD AND ITS CONTRIBUTION TO OTHER APPLICATIONS. 16th Nuclear Conference, Rome, Italy, March 25–26, 1971. Serie Simposi. Rome; Comitato Nazionale per l'Energia Nucleare (1972). 470p. (In Several Languages). (CONF-710317-).

From 16th nuclear congress; Rome, Italy (25 Mar 1971).

Fifteen papers were presented. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 8094–8100, 9969, 9970, 9980, 9997, 9998, 10016, 10017, and 10195.

8094 NUCLEAR HEAT STUDIES IN FRANCE AND THEIR NONNUCLEAR APPLICATIONS. Mondin, H. (CEN, Grenoble, France). pp 15-33 of Development of Thermal Techniques In The Nuclear Field And Its Contribution To Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In French).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

The principal developments of thermotechniques in the nuclear domain are briefly summarized, and the knowledge acquired during nuclear thermal studies is discussed. The nonnuclear applications are merely indicated by classification by nature of the knowledge applied and by classification by needs of the user. Application of the results to industrial construction is considered. (JSR)

8095 REPORT ON UKAEA DEVELOPMENTS OF THERMODYNAMICS IN THE NUCLEAR FIELD. Shires, G. L. (Atomic Energy Establishment, Winfrith, Eng.). pp 35-55 of Development of Thermal Techniques in the Nuclear Field And Its Contribution To Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

The heat transfer and fluid flow studies carried out by the UKAEA to provide design data for the SGHWR, in which light water is the primary coolant, have led to the accumulation of resources and expertise which it has been possible to apply directly to heat transfer problems in non-nuclear situations. This development was formalized by the Science and Technology Act of 1965 which led directly to studies in the desalination field and to more general studies which are now operated under the aegis of the Heat Transfer and Fluid Flow Service which operates for the benefit of industry as a whole. Thus, the expertise developed specifically for nuclear studies has found applications outside the nuclear field. (auth)

8096 DEVELOPMENTS IN HEAT TECHNOLOGY IN THE NUCLEAR FIELD AND THEIR CONTRIBUTION TO OTHER APPLICATIONS. Some Considerations On The Italian Situation. Franco, G. (CNEN, Casaccia, Italy). pp 79-154 of Development of Thermal Techniques In The Nuclear Field And Its Contribution To Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian)

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

Studies in the field of heat transfer and fluid dynamics of two-phase systems are categorized to indicate their applicability to fields other than the nuclear field. Initiatives taken to insure better relations between industry and research are indicated. Developments of thermotechniques in the nuclear area in Italian organizations and within the CNEN are summarized for each organization and CNEN division and laboratory. (JSR)

8097 THEORETICAL ANALYSES OF SUBCOOLED BOILING CRISIS. Tong, L. S. (Westinghouse Electric Corp., Pittsburgh). pp 157-172 of Development of Thermal Techniques In The Nuclear Field And Its Contribution To Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

Various existing theoretical analyses of the subcooled boiling crisis are consolidated and extended using two theoretical approaches. In the first, the boiling crisis is assumed to be governed by the convective heat transfer capability of the main flow. In the second, the controlling factor of the boiling crisis is assumed to be the cooling capacity of the wall liquid film. Both theoretical approaches produce results that agree favorably with experimental data. The heat and mass transfer coefficient at the interface of the wall liquid film and the main flow is identified as the common parameter connecting these two approaches. (LCL)

8098 CONTRIBUTION OF THE DEVELOPMENT OF NUCLEAR THERMODYNAMICS TO OTHER APPLICATIONS WITH PARTICULAR REFERENCE TO THE THERMOHYDRAULICS OF TWO-PHASE FLUIDS. Salvetti, C. (CNEN, Rome). pp 273-292 of Development of Thermal Techniques In The Nuclear Field And Its Contribution To Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From sixteenth nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

The contribution of the development of nuclear thermodynamics to other applications is cited in the case of steam generators with imposed temperature increase, transport of electrical energy with cryogenic cables, exchanger-evaporators or condensers with direct contact, heat exchangers with two-phase flow, bubble columns, quenching of metals, and high-efficiency liquid-gas separators. Three specific examples are given: design of a condenser-evaporating element, conversion of thermal energy into mechanical energy, and solidification of dust. (JSR)

8099 APPLICATION OF NUCLEAR TWO-PHASE THERMOHYDRAULIC DEVELOPMENTS TO NON-NUCLEAR EVAPORATOR SYSTEMS. Bachmann, U.; Frei, H.; Sharan, H. N. (Sulzer Brothers Ltd., Winterthur, Switzerland). pp 293-313 of Develop-

ment of Thermal Techniques In The Nuclear Field And Its Contribution To Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

Nuclear two-phase thermohydraulic developments which are finding non-nuclear application are discussed in detail and include research on the problems of the stability of convectively heated steam generators, burnout, and critical heat flux. It is recommended that there be a greater exchange of research information from industrial non-nuclear heat transfer specialists to the general body of heat transfer knowledge as well as the traditional contributions of the nuclear heat transfer specialists. (LCL)

8100 CORROSION PROBLEMS RELATED TO TWO-PHASE FLOW. Tillequin, J. F. (Societe Babcock-Atlantique, Paris). pp 371-389 of Development of Thermal Techniques In The Nuclear Field And Its Contribution To Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In French).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

Examples of corrosion in heat exchangers at Marcoule and Chinon-2 occurring in zones exposed to a relatively low heat flux and occurring only after a long period of operation are cited. The phenomenon can be classified as erosion-corrosion by a water-steam emulsion. Detection of similar corrosion in a classical boiler led to the construction of the CORINE loop for studying this problem. The loop is briefly described and the experimental studies projected for it are indicated. (JSR)

8101 DUAL-ENERGY METHOD FOR MEASURING VOID FRACTIONS IN FLOWING MEDIUMS. LeVert, F. E.; Helminski, E. (Tuskegee Inst., AL). Nucl. Technol.; 19: No. 1, 58-60 (Jul 1973).

A dual-energy photon attenuation technique provides a means of measuring void fractions in a flowing fluid. The mean void fraction determined by this method is independent of the fluid thickness. A comparison of the dual-energy method with the single-energy attenuation technique reveals that the assumption of a static reference void fraction in a dynamic voiding case is less severe with the dual-energy method. (auth)

Materials Testing

Refer also to abstracts 8315, 8616, 8624, and 8805.

8102 (ORNL-TM-3476) SECONDARY STRESS INDICES FOR INTEGRAL STRUCTURAL ATTACHMENTS TO STRAIGHT PIPE. Dodge, W. G. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 60p. Dep. NTIS $5.00.

A simplified method for calculating the stresses induced in straight pipe by thrust and moment loadings applied to lugs and other integral attachments is presented. Following the philosophy of the nuclear power piping portion of Section III of the ASME Boiler and Pressure Vessel Code, appropriate secondary stress indices are defined. A simple and conservative formula for computing the stress indices is developed using analytical results as a guide. A comparison is made between experimental stress indices and those obtained using the simplified analysis procedure developed here as well as the more complex analysis procedures of Welding Research Council Bulletin 107 (WRC-107 method). The method is extended to attachments having a variety of cross sections. (auth)

Nuclear Explosions

Refer also to abstract 10486.

8103 (AD-751523) EXTENDED ARRAY EVALUATION PROGRAM. Quarterly Report No. 2, 1 July–30 September 1972. Harley, T. W. (Texas Instruments Inc., Dallas). 15 Oct 1972. Contract F33657-72-C-0725. 17p. NTIS.

Progress during July to Oct. 1972 in the following areas is summarized: ALPA evaluation, NORSAR long period evaluation, NORSAR short period evaluation; VLPE evaluation; and network evaluation. (NTIS)

8104 (AD-751759) EXTENDED ARRAY EVALUATION PROGRAM. Special Report No. 1: Indirect Estimates of Surface Wave Detection Probabilities. Harley, T. W.; Heiting, L. N. (Texas Instruments Inc., Dallas). 1 Aug 1972. Contract F33657-72-C-0725. 15p. (TI-SR-1). NTIS.

Previously reported techniques for basing indirect estimates of the surface wave detection probability are shown to yield results inconsistent with direct estimates when applied to data from the Alaskan Long Period Array (ALPA). A modification to these techniques is proposed. It is demonstrated that this modified procedure yields indirect estimates very close to those observed directly. (auth)

8105 (AD - 753586) SWEM (STRATEGIC WEAPONS EXCHANGE MODELS) ALLOCATION MODEL: VERSION II. Final Report. Arms, R.; Grissmer, D.; Lyons, L. (Research Analysis Corp., McLean, VA). Dec 1972. Contract DAHC19-69-C-0017. 164p. (RAC-CR-71). NTIS.

SWEM Allocation Model is a mathematical optimization model which allocates strategic weapons in a two-sided nuclear exchange and provides damage results and specific allocations. The model is useful in defining levels of parity between the nuclear arsenals of two nations. Version 2 of the model expands the allocation matrix to include attack on defense installations and provides the optimal trade-off between attack of defense installations, weapon targets (silos) and cities. The document describes a mathematical optimization model which provides allocations and damage levels in a two-strike nuclear war. It is an extension of an allocation model (Strategic Weapons Exchange Allocation Model-Version I) which has been documented in manuals mentioned in the introduction. The new allocation model allows attack on defense installations as well as cities and weapon targets, and provides optimal trade-offs in allocation between defense installations, cities, and weapon targets. The document describes the capabilities and limitations of the model, gives the format of the input and output of the model, provides example problems and contains the annotated FORTRAN listing of the program. (auth)

8106 (BMI-171-151) AMCHITKA BIOENVIRONMENTAL PROGRAM. Limnology of Amchitka Island, Alaska. Annual Progress Report, July 1, 1971–June 30, 1972. Birch, T. J. (Battelle Columbus Labs., Ohio). Apr 1973. Contract AT(26-1)-171. 45p. Dep. NTIS $3.00.

Gross morphological changes to lakes as a result of Cannikin were largely limited to lakes within a 1-mile radius of Surface Zero. Four lakes near SZ were completely drained by tilting of their basins and/or cracking of their bottom seals and two others were partially drained. No new physical disturbances attributable to Cannikin were observed in lakes near Long Shot or Milrow SZ. A new lake was formed as a result of Cannikin. The lake, in the Cannikin subsidence crater, may become the largest lake on Amchitka. The crater was expected to reach near maximum depth by the fall of 1972. The flooding of drill mud materials by the waters impounded in the crater may create a minor pollution problem in the new lake. Observation of potential short-term effects to chemical and biological parameters in Amchitka lakes due to Cannikin was masked by the effects of a severe storm that struck Amchitka on D-1. While there were increases in spring of 1972 in values of pH and alkalinity of a sufficient magnitude, nature, and location to suggest a relationship to Cannikin, there was an apparent masking effect on subtle changes in water chemistry in the spring due to very dry weather. Concentrations of particulate organic matter were temporarily increased in a number of lakes as a result of Cannikin. Higher-than-normal values persisted into the spring in a few of these lakes. A number of additional disturbances to lakes and streams as a result of test-support activities are cited. (auth)

8107 (BNWL-1748) AIR STORAGE PEAKING POWER PLANTS: UTILIZING MODIFIED INDUSTRIAL GAS TURBINES AND CAVITIES CREATED WITH NUCLEAR EXPLOSIVES. Fryer, B. C. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1973. Contract AT(45-1)-1830. 40p. Dep. NTIS $4.00.

Efforts to reduce the cost of peaking power have led to a reconsideration of the air storage type peaking plant. In this peaking plant concept air is compressed and stored in a chamber during low demand periods. During peak demand periods air is withdrawn from the cavity, mixed with fuel, heated in a combustion chamber, and expanded through a turbine producing electrical power. A preliminary economic and technologic assessment of an air storage peaking power plant utilizing a modified industrial gas turbine and air storage cavities created with nuclear explosives is summarized. Cost estimates indicate that the air storage plant based on current gas turbine technology could produce peak power at significant savings over other types of plants, provided: air storage temperature is kept low; and site rock properties are conducive to the production of a high void volume per kiloton of explosive. Cost estimates based on 1980 gas turbine technology indicate that the air storage system is clearly economically competitive to other peaking systems—even under the worst possible conditions of air storage temperature and rock properties. (auth)

8108 (NVO-71) PROJECT RULISON: MANAGER'S REPORT. (Nevada Operations Office (AEC), Las Vegas). Apr 1973. 262p. (PNE-R-63). Dep. NTIS $15.25.

A summary of the administration, operational planning, safety, engineering, construction, and logistics performed by the Nevada Operations Office in support of the technical and scientific experiments conducted under Project Rulison through the postshot reentry program and the production phase is presented. (TFD)

8109 (NVO-103(Rev.3)) REPORTS AVAILABLE IN THE ALASKAN INFORMATION PROGRAM. (Nevada Operations Office (AEC), Las Vegas). Jan 1973. 21p. Dep. NTIS $3.00.

A bibliography is presented on documents relating to the AEC's underground nuclear tests on Amchitka Island. (JGB)

8110 (NVO-127) AEC PROJECT DIRECTOR'S OPERATIONS PLANS FOR PROJECT RIO BLANCO. (Nevada Operations Office (AEC), Las Vegas). Apr 1973. 141p. (PNE-RB-44). Dep. NTIS $9.25.

Ten plans which define field programs necessary to fulfill the responsibilities which have been assigned to the AEC Project Director for the Rio Blanco Event are presented. They include area control, security, nuclear safety, occupational safety and health, communications, public information and observer, radiological safety, technical reporting, complaints and/or claims procedures, and effects documentation. (TFD)

8111 (NVO-1163-237) TOPOGRAPHIC EFFECTS ON GROUND MOTION FOR INCIDENT P WAVES: A MODEL STUDY. Rogers, A. M.; Katz, L. J.; Bennett, T. J. (Environmental Research Corp., Las Vegas, Nev.). May 1973. Contract AT(29-2)-1163. 50p. Dep. NTIS $4.00.

A scale model experiment was conducted to study the effect of topography on ground motion for incident P waves. It was found that amplifications as large as 35% may occur in the time domain for a wide band input with predominant wavelength equal to the width of the scatterer base. The largest diffracted wave observed was a forward scattered Rayleigh wave with an amplitude about 55% of the incident motion. Examination of the spectral ratios showed that for more band-limited input pulses, peak amplifications of the crest motions relative to the base may be as high as 200%. These differences are comparable to, but smaller than, the 400% amplifications observed in field studies conducted by Davis and West (1973). Results of a parameter study indicate topographic effects to be weakly dependent on slope and angle of incidence. However, the effects do change significantly as a function of frequency and position on the scatterer. For receiver positions at depth significant scattered body waves were measured. The radiation lobes of these waves are predominantly downward. Qualitative agreement was found between the model results and field results observed on a nearly two-dimensional feature (NASA Mountain near Beatty, Nevada) where underground nuclear explosion ground motions were recorded. For instance, a forward scattered Rayleigh wave with amplitude about equal to the incident motion was identified immediately following the incident Pg. (auth)

8112 (NVO-1163-238) RAYLEIGH WAVES FROM A NUCLEAR SOURCE IN A HALFSPACE. Murphy, J. R. (Environmental Research Corp., Las Vegas, Nev.). May 1973. Contract AT(29-2)-1163. 41p. Dep. NTIS $4.00.

An analytical model is described which can be used to calculate the Rayleigh wave and permanent surface displacement components produced by a nuclear source in a halfspace. It is shown that in the far-field the permanent radial surface displacement is proportional to r^{-2} while the permanent vertical surface displacement is proportional to r^{-3}, where r is the horizontal range. A series of parametric calculations are presented which indicate that the amplitude and frequency content of the Rayleigh wave displacement on the surface of a halfspace is strongly dependent on source depth. It is shown, however, by using the seismic reciprocity theorem that such a pronounced depth dependence would not be expected for a nuclear source in a multilayered halfspace. (auth)

8113 (PNE-RB-45) PROJECT RIO BLANCO. Project Directors' Preliminary Report; D + 2 Days. (Nevada Operations Office (AEC), Las Vegas). 21 May 1973. 40p. Dep. NTIS $4.00.

The Rio Blanco Project is described as to experimental conditions, chronology of the project, and operations associated with the detonation and subsequent effects monitoring. All known experimental results as of 1000 h Mountain Daylight Time, May 19, 1973 are summarized. The explosive effects are discussed in terms of measured ground motion, aftershocks, and the response of natural and man-made structures. The bioenvironmental damage, i.e., injury to livestock and wildlife is evaluated. No radioactivity above background level was detected in the environment. (LCL)

Protective Structures and Equipment

Refer also to abstract 8230.

Safety Engineering

Refer also to abstracts 8280 and 8281.

8114 (Y-DR-110) NUCLEAR STANDARDS. Callihan, D. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

This document presents a general description of the organization and procedures for promulgating American National Standards applicable to the nuclear industry and discusses the support to the program by various organizations and agencies. The recognition of Standards in the regulatory process of the U. S. Atomic Energy Commission is cited. (auth)

8115 SAFETY CONTACTS OF DOORS OF RADIOGRAPHIC ROOMS. Waite, R. T. Health Phys.; 24: No. 6, 684(Jun 1973).

Reference is made to the explanation by Bushong (Health Phys.; 23: 392-4 (1972)) of the necessity for interlocks on the doors of radiographic rooms. It is stressed that in fact the device described is not an interlock but a contact and this is indeed what is required for radiographic doors. The necessity that the device should be fail-safe is also stressed. The contact should be arranged so that it is closed by spring action and positively opened by the door thus making it as fail-safe as possible. (UK)

Vacuum Engineering

Refer also to abstract 8877.

8116 (IPPJ-DT-28) TRIAL MANUFACTURE OF SCHULZ-TYPE IONIZATION VACUUM GAUGE AND ITS CHARACTERISTICS. Ootsuki, S.; Akaishi, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1971. 8p. (In Japanese). NTIS (U. S. Sales Only).

Trial manufacture of a Schulz-gage was performed, which was used as an ionization vacuum gage in the pressure range of a plasma experiment. In order to improve performance of vacuum gages available on the market, which include a short life of the rhenium filament and an appreciable electric leak between electrode stems, an iridium filament with thoria electrodeposited on its surface and construction that could reduce leak current below 10^{-12} A were adopted. Filament temperature of 1340°C measured with an optical pyrometer was recognized to be sufficiently low, compared with the 2454°C melting point of the iridium. So, the filament was expected to have a longer life. Since sag of the filament by thermal-expansion was forecast, the filament stretch was favorably absorbed by inserting bimetal lead at one end. Measurable pressure range was 0.4 to 10^{-6} torr, at grid-filament potential of 200 volts, and emission current of 20 μA. (JA)

8117 DIAPHRAGM COMPRESSORS AS AUXILIARY EQUIPMENT IN NUCLEAR ENGINEERING. Boehme, J. Kerntechnik; 15: No. 4, 178-182(1973). (In German and English).

Diaphragm compressors and diaphragm vacuum pumps with plastic diaphragms are particularly suitable as pressure or vacuum generating units for applications requiring small delivery rates in the range from 1.5 to 600 l/min, pressures up to 12 bar or ultimate vacuums down to 1.5 torr, and where it is necessary to ensure leaktightness down to 5×10^{-8} torr l/s. The working principle of these devices is explained for a single and a double diaphragm system; this latter ensures a substantially higher operating safety and is therefore particularly suitable for various nuclear engineering tasks, such as conveying gaseous fission products. A particular advantage of diaphragm compressors is the generation of oil-free compressed air and the possibility of conveying gases and vapors without any contamination by oil. Examples of practical applications are described. (GE)

8118 IMPROVEMENTS TO ION SOURCES FOR ION GAGES. Chaumoff, S.; Gautherin, G.; Lapteef, B. (to Societe General du Vide). French Patent 2,119,204. 4 Aug 1972. Filed date 23 Dec 1970. 11p. (In French).

An ion source intended for a very low pressure (ultravacuum) gage is presented. This source produces a high ion current with a very low power input (10^{-7} watts), and can thus be used at very low temperatures (a few degrees K). The utilization of a photoemissive cold cathode magnetron source enables the magnetron effect to be used to increase the ionization yield. (FR)

8119 AN IONIZATION GAUGE USING A CHANNEL ELECTRON MULTIPLIER FOR PRESSURES BELOW 10^{-12} TORR. Blechschmidt, D. (CERN European Organization for Nuclear Research, 1211 Geneva 23, Switzerland). J. Vac. Sci. Technol. 10: No. 2, 376-380 (Mar 1973).

A new ionization gauge of an estimated low pressure limit below 10^{-15} Torr and of a sensitivity of 2×10^{9} $Torr^{-1}$ is presented. The ions, which are produced in an ionizer of conventional design, are

extracted through a shield aperture and collected by the funnel-type cathode of a channel electron multiplier. Since the high gain of this multiplier allows the gauge to be operated with an emission current of only several nanoamperes, practically no heat is produced in the gauge. The gauge is mounted on a $4\frac{1}{2}$-in. flange and has approximately the size of a normal Bayard-Alpert gauge. A general expression for the low pressure limit of hot filament ionization gauges is given. The results as obtained from this expression for gauges of similar geometry are discussed together with the low pressure limit as found for the new gauge. (auth)

8120 INSTRUMENTAL METHOD FOR HIGH-VACUUM HANDLING. Martínez Guerrero, J.; Rodríguez, Gil (Instituto de Geofísica, UNAM, México, D.F.). J. Vac. Sci. Technol. 10: No. 2, 398-400 (Mar 1973).

A manipulator is described, especially constructed to be connected to a high-vacuum multirotator, with the aim of proving that the system may be used to develop maneuvers within a high vacuum. The resultant device may be managed after a few moments of instruction and it is possible to program it so that it acts in a robotlike manner to carry out routine operations. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 8224.

8121 POLONIUM RADIOHALOS: AN ALTERNATE INTERPRETATION. Moazed, C.; Spector, R. M.; Ward, R. F. (Wayne State Univ., Detroit). Science; 180: No. 4092, 1272-1274(22 Jun 1973).

A study of the sizes of so-called polonium radiohalos of various types found in biotite from Bancroft, Ontario, has been carried out. The evidence is consistent with the interpretation that these halos are variants of the standard uranium halos. A review of the literature indicates that there is no firm evidence that polonium halos exist, all evidence being equally consistent with the interpretation that these are uranium halos. (auth)

8122 REVALUATION OF THE MARINE GEOCHEMISTRY OF URANIUM. Sackett, W. M.; Mo, T.; Spalding, R. F.; Exner, M. E. (Texas A and M Univ., College Station). pp 757-769 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Approximately 10^{15} μg/yr of dissolved uranium are being removed from the ocean by each of the generally accepted significant sinks for uranium-carbonate deposits and deep anoxic basin sediments. However, these sinks account for only 10% of the estimated present-day input of uranium. Possible explanations for this discrepancy are: contemporary input values are too high owing to a significant contribution from man's effects, such as uranium input via phosphate fertilizers or world-wide cultivation leading to premature leaching of uranium from soils; or there are other important uranium sinks such as the abundant siliceous oozes or continental shelf anoxic sediments. (auth)

Radioactive Effluents

Refer also to abstracts 8141, 8427, and 10272.

8123 (BNWL-1651(Pt.1)) ANNUAL REPORT FOR 1971 TO THE USAEC DIVISION OF BIOLOGY AND MEDICINE. Volume II. Physical Sciences. Part 1. Atmospheric Sciences. Simpson, C. L. (Battelle Pacific Northwest Labs., Richland, Wash). Dec 1972. Contract AT(45-1)-1830. 198p. Dep. NTIS $3.00.

Separate abstracts were prepared for 46 sections of this report. Fourteen papers published during the period covered by the report are listed. (CH)

For abstracts of individual sections see: 7872, 8124–8130, 8145–8148, 8203, and 10514–10546.

8124 (BNWL-1651(Pt.1), pp 73-82) KINEMATICALLY POSSIBLE FLOWS EXTERIOR TO JETS AND PLUMES. Slinn, W. G. N. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

A progress report is given of analytical analyses of flows exterior to jets and plumes penetrating into the half space $z > 0$. It is shown that the exterior flow is essentially horizontal near a plume and the case of nonzero mean wind and multiple plumes can then be treated using superposition. Qualitative results are presented for bifurcation and merging of plumes. Such studies are intriguing when one considers whether or not there exists an optimum arrangement of cooling towers in the neighborhood of a nuclear reactor, such that if there were an accidental release of radioactivity, it would be entrained by the cooling tower plume, brought to a higher elevation, and thereby dispersed less hazardously, or the potential hazards caused by entrainment into moist cooling tower plumes of pollutants from fossil-fuel-plant plumes and the possible enhanced production of sulfuric acid. (CH)

8125 (BNWL-1651(Pt.1), pp 118-119) ^{85}Kr FIELD MONITORING SYSTEM AND ITS APPLICATION TO MAXIMUM AIR DOSE MEASUREMENTS OF A RADIOACTIVE GAS. Ludwick, J. D.; Nickola, P. W. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

Improvements to the ^{85}Kr diffusion grid monitoring system are described which include an increase in the number of detectors, an expansion of the programmer memory, and an increase in data transfer speed. (auth)

8126 (BNWL-1651(Pt.1), pp 119-122) PRELIMINARY CONCENTRATION MEASUREMENTS OF PUFFS RELEASED DURING NEAR CALM WINDS. Nickola, P. W.; Ludwick, J. D. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

The Hanford inert gas field grid has been revised in order to better measure puffs of ^{85}Kr released under stagnant atmospheric conditions. To date, two puffs have been released on this grid. Results from these tests suggest that if tracer concentration is considered as a function of distance, the stagnation conditions produce lower concentrations than do releases into stable atmospheres with steady wind directions. In considering short period (5 sec) mean concentrations as a function of time, stagnation tests produced higher concentrations than the steady wind case at times greater than 500 seconds after release. (auth)

8127 (BNWL-1651(Pt.1), pp 123-125) COMPARISON OF EXPOSURES RESULTING FROM INERT GAS RELEASES WITH EXPOSURES PREDICTED WITH THE AID OF PASQUILL'S DIFFUSION CATEGORIES. Nickola, P. W. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

Normalized exposures resulting from near ground level release and sampling of plumes of ^{85}Kr inert gas tracer were lower than exposures predicted with the aid of graphs based on Pasquill's diffusion categories. Since concentration reducing processes other than turbulence and diffusion should be minimized by use of an inert tracer, these results suggest that Pasquill's curves are too conservative. Exposures resulting from instantaneous puff releases were found to average three times the magnitude of those resulting from 10 to 20-minute plume releases. (auth)

8128 (BNWL-1651(Pt.1), pp 126-130) EXAMINATION OF THE RELATIONSHIP BETWEEN THE SIZE AND SHAPE OF THE REAL PLUME AND ITS POSITION. Ramsdell, J. V. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

The assumption that the size and shape of a real (instantaneous) plume are independent of the position of its centroid at any fixed distance from the source is crucial to fluctuating plume models. This assumption is examined using ^{85}Kr data and time series analysis. (auth)

8129 (BNWL-1651(Pt.1), pp 130-133) ABSOLUTE PEAK-TO-MEAN CONCENTRATION RATIOS. Ramsdell, J. V. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

Absolute peak-to-mean concentration ratios are defined as the ratio between a maximum short-term concentration at any given position and the time-average concentration at the mean plume axis. They are examined as a function of both position in the plume and the time ratio, using ^{85}Kr as tracer. A comparison between conventional and absolute peak-to-mean ratios is shown. (auth)

8130 (BNWL-1651(Pt.1), pp 134-136) EXTENSION OF THE PEAK-TO-MEAN CONCENTRATION RATIO MODEL. Ramsdell, J. V. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

The peak-to-mean concentration ratio model developed in 1969 using ^{85}Kr as tracer for ground-level plumes is extended to predict ground-level peak-to-mean ratios in elevated plumes. (auth)

8131 (BNWL-CC-995) SOIL RADIONUCLIDE ADSORPTION AND PARTICULATE FILTRATION IN AN N-AREA SOIL. Carlile, B. L.; Hajek, B. F. (Battelle Pacific Northwest Labs., Richland, Wash.). 18 Jan 1967. Contract AT(45-1)-1830. 16p. Dep. NTIS $3.00.

Interim experimental results are reported from an investigation of the extent of radionuclide movements, both ionic and particulate, from a Hanford ground disposal facility designed for disposal of radioactive waste coolant generated in the event of a reactor primary loop failure incident. Laboratory soil column investigations with high activity ^{137}Cs and ^{90}Sr solutions showed breakthrough values to be appreciably higher than previously extrapolated predictions for the soils. From the breakthrough pattern obtained in the initial phase of this study, it was evident that some phenomena other than ion exchange was responsible for this effluent activity. The three possible mechanisms of activity transportation are ionic solution transport, diffusive movement, and colloidal or particulate migration. Since only the latter mechanism could result in the breakthrough pattern obtained in this

study, the possibility of particulate migration was investigated, and preliminary results are reported. (CH)

8132 (BNWL-SA-4511) APPLICATIONS OF A GENERAL COMPUTATIONAL MODEL FOR COMPOSITE ENVIRONMENTAL RADIATION DOSES. Soldat, J. K.; Baker, D. A.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. Contract AT(45-1)-1830. 18p. (CONF-730503-5). Dep. NTIS $3.00.

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en Provence, France (14 May 1973).

The original development of the mathematical model and the further modifications and applications are reviewed for calculating radiation doses for human populations for the environmental statements required by the USAEC licensing procedure for nuclear facilities, and for hypothetical releases of nuclear wastes after extremely long periods of storage. The original dose calculation scheme was devised as part of the computer program HERMES designed to: define the nuclear power economy potentially in place in the year 2000; site the required nuclear facilities; estimate the release and dispersion of their radioactive effluents; calculate resulting radionuclide concentrations in air and water, and on soil and sediment; calculate concentrations in foodstuffs; and calculate radiation doses from intakes of air, water, and foods, and from external exposure to air, water, and ground. (CH)

8133 (CONF-700124) ENVIRONMENTAL RADIOACTIVITY SYMPOSIUM, JOHNS HOPKINS UNIVERSITY, JANUARY 19–20, 1970. Clopton, J. C. (ed.). (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Geography and Environmental Engineering). 1 Nov 1970. 278p. Johns Hopkins Univ., Baltimore, Md. $5.00.

Separate abstracts were prepared for each of the six papers that discuss various aspects of the control of radioactivity in the environment. (CH)

For abstracts of individual papers see: 8134, 8176, 8177, 8396, 10487, and 10488.

8134 (CONF-700124-, pp 5-33) RADIOACTIVITY: SOURCES AND ENVIRONMENTAL DISTRIBUTION. Weaver, C. (Bureau of Radiological Health, Rockville, MD.). 1 Nov 1970.

From environmental radioactivity symposium; Baltimore, Maryland, USA (19 Jan 1970).

In environmental radioactivity symposium.

The Bureau of Radiological Health is the health agency of the Federal Government that is principally responsible for evaluating population exposure from the operations of nuclear power plants. A technical review and evaluation are developed for each nuclear power station to assure that, the health and safety of the people are protected, and that something does not happen about which we are not knowledgeable. In order to carry out this activity it is necessary to develop competence. It is postulated that, with the knowledge that we now have, we should be able to provide much better information to the public. (CH)

8135 (RLO-2227-T-12-38) EFFECTS OF OCEAN WATER ON THE SOLUBLE-SUSPENDED DISTRIBUTION OF COLUMBIA RIVER RADIONUCLIDES. Evans, D. W. (Oregon State Univ., Corvallis). Jun 1973. 65p. Dep. NTIS $5.25.

Thesis.

The relationship of dissolved concentrations of Hanford radionuclides with salinity in the Columbia River estuary was interpreted in terms of the exchange of the radionuclides between dissolved and suspended particulate phases. Both ^{65}Zn and ^{54}Mn carried by the Columbia River were partially desorbed from suspended particulate matter upon mixing with ocean water in the estuary. Experiments in which ocean water was added to Columbia River water and to suspended particulate matter collected on filters confirmed the partial desorption of ^{65}Zn and ^{54}Mn from the particulate phase. The percentage of ^{65}Zn and ^{54}Mn desorbed varied with experimental approach but desorption of ^{65}Zn seemed to lie in the range 15% to 45% and ^{54}Mn in the range 30% to 60%. None of the experiments revealed any effect of salinity on the soluble-suspended particle distribution of ^{51}Cr, ^{124}Sb, or ^{46}Sc. Dissolved concentrations of these nuclides varied inversely with salinity. There was no evidence that any of the radionuclides studied were removed from solution by flocculation, precipitation, or adsorption as the result of mixing with ocean water. Ocean water contact partially removed ^{54}Mn but not ^{65}Zn, ^{46}Sc, or ^{60}Co from Columbia River bottom sediments transferred to the marine environment. The inability of ocean water to desorb ^{65}Zn from bottom sediment contrasts with its action with suspended particulate ^{65}Zn. (auth)

8136 (WASH-1209) POTENTIAL RADIOLOGICAL IMPLICATIONS OF NUCLEAR FACILITIES IN THE UPPER MISSISSIPPI RIVER BASIN IN THE YEAR 2000. The Year 2000 Study. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 242p. GPO.

The radiation potentially received by the population of the upper Mississippi River Basin (UMRB) study area, which might result from the operation of nuclear power and fuel reprocessing facilities in the year 2000, is considered. Those facilities assumed to be operating in that year, in the UMRB study area and the surrounding region included an aggregate nuclear generating capacity of 356,000 MWe (assumed to consist of 46,000 MWe of BWRs, 138,000 MWe of PWRs, and 172,000 MWe of LMFBRs), plus nine nuclear fuel reprocessing facilities (8 plants of 5 tonne per day capacity plus the existing 1 tonne/day Morris facility). Radionuclide releases from these facilities were estimated, transport through the region was modeled, and the resulting concentrations were used to calculate radiation exposure to the 29.1 million inhabitants of the UMRB study area. The results of the study of the UMRB based on the selected radiation waste treatment systems showed that, on the average throughout the region, the potential radiation an average individual could receive in the year 2000 would be increased by roughly 0.2 millirem/year because of the presence of nuclear facilities. This is only slightly more than one-tenth of one percent of the roughly 140 millirems/year received from natural sources, about two-tenths of one percent of that received from medical and dental sources such as diagnostic x rays, and only one percent of that received from other manmade sources such as television set components and luminous watch dials. (CH)

8137 ENVIRONMENTAL ASPECTS OF NUCLEAR ENERGY. Collee, R. (Univ., Liege). Trib. Cebedeau (Cent. Belge Etude Doc. Eaux); 26: No. 350, 18-28(1973). (In French).

Nuclear energy possesses, among others, several appreciable intrinsic advantages such as low cost of fuel and great energy autonomy. Electronuclear power plants do not contribute to atmospheric pollution with carbon dioxide nor to the destruction of ecological equilibrium. They do not release sulfur compounds, contrary to fossil fuels the use of which would be generally prohibitive if the protection of the environment requires purification treatments (in this regard, petroleum having less than 1% of sulfur would represent hardly 15% of the total). The problem of radioactive wastes is a long-term one but it appears to be resolved for a short term by storage in shielded and localized storage places. (EJH)

Radioactivity Monitoring and Transport

Refer also to abstracts 8398, 10487, and 10488.

8138 (BNWL-1727(Add.)) ENVIRONMENTAL SURVEILLANCE AT HANFORD FOR CY-1972. Bramson, P. E.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash.). Apr 1973. Contract AT(45-1)-1830. 112p. Dep. NTIS $7.75.

Results obtained from both analyses of environmental samples and from radiological measurements made in the Hanford environs during 1972 are compiled. The significance of these data is discussed in the parent report (BNWL-1727). (CH)

8139 (SCPRI(RM)-12-1972) REPORT OF ACTIVITY, DECEMBER 1972. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1972. 16p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Data are presented on the sources of radioactivity in environmental samples collected at various locations throughout France during December 1972. (CH)

8140 (SCPRI(RM)-12-1972(Suppl.)) ANNEX TO MONTHLY REPORT, DECEMBER 1972. DETAIL OF RESULTS OF MEASUREMENT. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1972. 20p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

Tabulated data on the radioactivity in environmental samples collected in France during December 1972 are presented. (CH)

8141 (STI/PUB-313) RADIOACTIVE CONTAMINATION OF THE MARINE ENVIRONMENT. Proceedings Series. Proceedings of a Symposium on the Interaction of Radioactive Contaminants with the Constituents of the Marine Environment held at Seattle, Washington, July 10-14, 1972. (International Atomic Energy Agency, Vienna (Austria)). 1973. 798p. (In Several Languages). (Conf-720708--). IAEA $27.00.

Separate abstracts were prepared for thirty-one of the forty-eight papers presented. The remaining papers were abstracted previously in NSA as: 26:41066; 26:45530; 26:45531; 26:45543; 26:45544; 26:45545; 26:50609; 26:50982; 26:53166; 27:2539; 27:2834; 27:7807; 27:22791; and 28:2596. (DHM)

For abstracts of individual papers see: 7887, 8122, 8142, 8163–8175, 8184–8186, 8199, 8206, 8331, 8386, 8462, 8486, 8487, 8508,. 8517–8519, and 8525.

8142 GEOCHEMISTRY OF RADIOCARBON IN THE GULF OF MEXICO. Mathews, T. D.; Fredericks, A. D.; Sackett, W. M. (Texas A and M Univ., College Station). pp 725-734 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

This study was conducted in an effort to achieve a better understanding of the contemporary geochemistry of radiocarbon in the Gulf of Mexico and adjacent areas. Fallout ^{14}C was found in four of five biological samples, explained by the feeding habits of the organisms; in two samples of fast-growing staghorn corals, reflecting the average composition of their aqueous environment; in three atmospheric samples which show a decrease in $\Delta^{14}C$ from +680‰ in December to +202‰ in November 1971; and in six river-water samples with an average $\Delta^{14}C$ of about +100‰. One of the most important results of this work has been the mapping of the fallout ^{14}C distribution in the Gulf. The high $\Delta^{14}C$ values of approximately +200‰ found for surface water samples are no surprise, due to the influence of atmospheric nuclear weapons testing. This value is in contrast to surface water in 1962 with a value of −49‰. The downward migration of this fallout ^{14}C has now been noted at depths in excess of 100 m, e.g., at 1000 m in the western Gulf $\Delta^{14}C$ is ~ −100‰ (1971) as opposed to ~ −150‰ (1962). The eastern Gulf has $\Delta^{14}C$ values distinctly higher at depths between 500 and 1500 m ($\Delta^{14}C \sim 0$) indicating quite low exchange rates between the two regions. In addition to the above trends, values far lower than typical surface values were found in the surface water along the Campeche Bank extending to its eastern boundary. Instead of +200‰, samples showed values from +15 to +187‰, thus indicating upwelling in the region. A circulation model for the western Gulf of Mexico was also proposed. Lateral transport from east to west and downward migration owing to eddy diffusion were suggested as mechanisms of renewal of intermediate and deep water in the western Gulf. Residence times for these water masses were found to be 120 years and 270 years, respectively. (auth)

8143 MEASUREMENT OF THE TOTAL β ACTIVITY AND POTASSIUM ACTIVITY OF BALTIC AND ATLANTIC HERRING AND OF CANNED HERRING IN TOMATO SAUCE. Nabrzyski, M.; Kotarski, J.; Zygmanska, J. (Academy of Medicine, Danzig). Gdansk. Tow. Nauk., Rozpr. Wydz.; 3: No. 8, 195-206(1971). (In Polish).

Measurements were made on total β and K activity in herring caught during 1969 in the Baltic Sea, in frozen Atlantic herring, and in canned herring. The total β activity of the Baltic herring was less than 3 p Ci/g fresh mass, while that of the Atlantic herring was slightly more. The K β activity was 85 to 95% of the total β activity. The fresh Atlantic herring had ~20% higher K and slightly higher total β activity than the Baltic herring. (HLW)

Atmosphere

Refer also to abstract 8212.

8144 (AD-754144) SEER II: A NEW DAMAGE ASSESSMENT FALLOUT MODEL. Lee, H.; Wong, P. W.; Brown, S. L. (Stanford Research Inst., Menlo Park, Calif). May 1972. Contract DASA01-71-C-0121. 138p. (DNA-3008-F). NTIS.

A simplified fallout computational system was developed for use in damage-assessment studies where very large numbers of weapons are used. A statistical procedure to relate wind variability to fallout pattern variability was also developed. Basic requirements of the simplified fallout computational system are that it simulate DELFIC fallout exposure rate contours and DELFIC accumulated exposure doses anywhere within the areas of significant fallout for identical input winds and weapon yield, and that the computer time for exercising the simplified fallout computational system be minimal. The wind variability to be considered was limited to the statistical probability of observing a given vertical wind profile over a given geographical location of any instant in time. Because the original simplified fallout computational system that was developed, Simplified Estimation of Exposure to Radiation (SEER), could not simulate DELFIC output for severely sheared winds, a new model, SEER II, was developed with this capability. The computer computation time required by SEER II on the CDC 6400 computer is approximately three seconds for weapon yields in the low kiloton range and six seconds for weapon yields in the 10 megaton range per 1200 grid points, which is approximately one-fiftieth to one one-hundredth of the computation time required by DELFIC. The SEER II output simulates DELFIC output reasonably well over a wide range of yields (1 kiloton to 30 megatons), and diverse wind structures. (auth)

8145 (BNWL-1651(Pt.1), pp 33-36) PRECIPITATION WASHOUT OF GASEOUS TRITIUM COMPOUNDS. Hales, J. M. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

A theoretical analysis of the washout of tritium compounds from plumes has been completed. Based upon reversible gas-washout theory this analysis provides a means for calculating washout concentrations from plumes of various geometries, including the bivariate-normal distribution. At present no field measurements exist to check the validity of this analysis for tritium compounds; data for SO_2 washout, however, indicate that agreement between theory and measurement should be acceptable under most circumstances. (auth)

8146 (BNWL-1651(Pt.1), pp 82-87) AIRBORNE RELEASE OF PLUTONIUM AND ITS COMPOUNDS DURING OVERHEATING INCIDENTS. Mishima, J.; Schwendiman, L. C. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

A series of studies to evaluate the fractional airborne release of plutonium under various postulated accident conditions has been in progress for some time. Data generated in earlier laboratory scale studies are reviewed. A larger scale facility (the radioactive aerosol release facility) was placed in operation providing the capability for measurement of fractional airborne release of radioactive particles from burning material on a more realistic scale. Uranium compounds were used as a simulant for Pu. The amount and aerodynamic equivalent size distribution of particles that may become airborne under conditions found in some shipping accidents were measured in experiments conducted in a special wind tunnel. (auth)

8147 (BNWL-1651(Pt.1), pp 88-90) CHARACTERIZATION OF RADIOACTIVE PARTICLES IN A PLUTONIUM PROCESSING PLANT EXHAUST SYSTEM. Mishima, J.; Schwendiman, L. C. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

Filter and cascade impactor samples were taken of the stack gases and various exhaust streams of a plutonium processing plant to characterize by aerodynamic characteristics the amounts and distribution of particles with their associated radioactivity. Only general conclusions can be drawn from the limited data obtained thus far: the overall efficiency of the exhaust system is high; little, if any, of the alpha activity leaving the stack is being recycled back into the ventilation system; and the plutonium present appears to be attached to large, nonactive particles. (auth)

8148 (BNWL-1651(Pt.1), pp 104-110) FALLOUT RATES AND MECHANISMS. Perkins, R. W. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

The concentrations of trace elements, cosmogenic radionuclides (^{24}Na, ^{38}Cl, and ^{39}Cl), and nuclear-weapons-produced radionuclides (^{55}Fe, ^{90}Sr, ^{7}Be, ^{95}Zr, ^{106}Ru, ^{137}Cs, and ^{144}Ce) were measured in the air from ground level to 19 km and in rain and seawater in order to determine the origin and chemistry of the atmospheric aerosol and to study the rates of atmospheric and oceanic mixing, the rates of air-sea interchange, and the rates and mechanisms of dry and wet fallout. Fallout deposition at Point Barrow, Alaska and Richland, Washington during 1971 is reported. (CH)

8149 (EGG-1183-1552) RADIOLOGICAL SURVEY OF THE NEVADA TEST SITE. (Survey Period: 1970–1971). Technical Report No. L-1064. (EG and G, Inc., Las Vegas, Nev.). 1 Aug 1972. 104p. Dep. NTIS 17.25.

The Nevada Aerial Tracking System (NATS), operated for the United States Atomic Energy Commission by EG&G, Inc., was used to perform aerial radiological surveys of the Nevada Test Site (NTS) and surrounding area during 1970 and 1971. All areas of the NTS and areas within five miles of the NTS boundary over which the NATS aircraft could operate at 300 feet altitude were surveyed. The data collected on these surveys include the gross count rate for gamma radiation between 50 keV and 3.0 MeV, and gamma spectra taken at 300 feet altitude. The gamma gross count data were used to determine radiation exposure rates, which were normalized to an equivalent value three feet above ground and processed into isoexposure rate contours. Gamma spectral plots are given and radionuclides are listed that are consistent with photopeaks found in the spectral plots. (auth)

8150 (KFK-1638, pp 223-230) RESULTS OF ROOM AND EXHAUST AIR MONITORING IN THE KARLSRUHE NUCLEAR RESEARCH CENTER. Koenig, L. A. (Kernforschungszentrum, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

Statistical results are reported about the monitoring of room and exhaust air at the Karlsruhe nuclear research center for the years 1970 and 1971. The relationship between air and surface contamination is also treated. Problems resulting from the legal definition of the maximal permissible concentration are discussed. The main difficulties spring from two sources. First, the available measuring devices indicate directly the concentration only in exceptional cases. Second, the concentration of radioactivity is constant neither with respect to time nor space. (HBG)

8151 (NP-19751) THREE HOUR MEASUREMENT OF THE RADIOACTIVITY IN THE ATMOSPHERE CLOSE TO THE EARTH IN THE YEAR 1972. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). 1972. 13p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

8152 (NP-19753) MEASUREMENT OF THE RADIOACTIVITY IN THE ATMOSPHERE IN THE YEAR 1972. (Zentralanstalt fuer Meteorologie und Geodynamik, Vienna (Austria)). 1972. 13p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

8153 (ORO-3944-6) STUDY OF TRITIATED HYDROGEN AND ITS COMPOUNDS IN THE ENVIRONMENT. Progress Report, August 15, 1972–April 15, 1973. Oestlund, H. G. (Miami Univ., Fla. Rosenstiel School of Marine and Atmospheric Sciences). 1973. Contract AT(40-1)-3944. 25p. Dep. NTIS $3.25.

The tropospheric HTO values continue to show the seasonal pattern caused by the spring leak of stratospheric bomb tritium (HTO) to the trophosphere. After the previous rise from prenuclear levels, the entire atmospheric HT inventory is now at a steady state at about 50 atoms of T per mg of air. Regular sampling from the three ground-level stations exhibits more or less clearly observable peaks coinciding with the ^{37}Ar peaks found in Switzerland and also occurring after large underground nuclear tests. The vertical distribution of HT also indicates its source to be at ground level, and additional possible sources are reprocessing of nuclear fuel elements and military and civilian handling of tritium gas. In the troposphere, there is now more tritium as gas (HT and T_2) than as HTO. (auth)

8154 INDUCED RADIOACTIVITY OF THE ATMOSPHERE OVER CZECHOSLOVAKIA IN THE PERIOD 1967–1971. Santroch, J. (Hydrometeorological Inst., Prague). Jad. Energ.; 19: No. 5, 152-155(May 1973).

The radioactivity monitoring service of the Hydrometeorological Institute measures the atmospheric radioactivity since 1962. The monitoring is carried out by 10 stations over Czechoslovakia measuring the radioactivity of fallout and airborne dust. The samples are processed, counted, and evaluated in Prague and in Bratislava according to the program of meteorological services of socialist countries. The methods of collection, processing, and measuring of samples are presented. Results of total beta radioactivity of airborne dust and fallout in the period 1967 through 1971 and concentrations of ^{137}Cs and ^{144}Ce in air near ground level are given. Hot particles from Chinese explosion of 18th March 1972 are described and analyzed. In the spectrum the presence of ^{95}Zr, ^{141}Ce, ^{140}Ba, and ^{237}U was determined. (auth)

8155 EFFECT OF METEOROLOGICAL FACTORS AND THE ENCLOSED SARAJEVO VALLEY ON THE DISTRIBUTION OF RADIOACTIVE AEROSOLS. Pasic, H.; Petrovic, Z. (Univ., Sarajevo, Yugoslavia). Meteorologie; No. 10, 241-249(Apr 1969). (In French).

From 10th international congress on alpine meteorology; Grenoble, France (2 Sep 1968).

The changes in the concentration of short half-life natural radioactive aerosols in the Sarajevo atmosphere were studied. The measurements made indicated that significant differences exist between the concentrations found in the enclosed valley and those found in the mountains surrounding the town. In most cases, the concentration found in the valley is greater than that found in the surrounding mountains and it is observed that certain meteorological parameters are of considerable importance. Correlation relations are used to relate changes in radon and thoron concentrations to meteorological factors. (France)

8156 ANALYSIS OF PARTICLE SIZE AND RADIOACTIVITY OF ATMOSPHERIC DUST. Bergamini, P. G.; Palmas, G.; Piantelli, F.; Rigato, M. (Univ., Siena, Italy). Health Phys.; 24: No. 6, 655-663(Jun 1973).

In Siena, over a period of 3 yr, atmospheric dust was collected by means of impaction and electrostatic precipitation. The radioactivity of the dust collected was analyzed and analysis was made of the particle size distribution. The relations of particle sizes and associated radioactivity are given and the effect of humidity is discussed. (auth)

8157 MAXIMUM PERMISSIBLE CONCENTRATIONS OF RADON, THORON, AND ACTINON, AND THEIR PRODUCTS IN WATER AND AIR. Gusarov, I. I.; Andreev, S. V. (Central Research Inst. of Health and Physiotherapy, Moscow). Gig. Sanit.; No. 2, 55-58(Feb 1973). (In Russian).

On the basis of an analysis of toxicological, biophysical, dosimetric, occupational pathologic, and hygienic aspects of the problem and summing up published and personal research data, the authors give the values and forms of the maximum permissible concentrations of radon and its daughter products in the air. (auth)

Soil

Refer also to abstract 8523.

8158 (NIRS-RSD-37) RADIOACTIVITY SURVEY DATA IN JAPAN. (National Inst. of Radiological Sciences, Chiba (Japan)). Nov 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

Data are presented on the ^{90}Sr and ^{137}Cs contents of soil, drinking water, potable rainwater, vegetable, and milk samples collected at selected sites in Japan during 1971 and 1972. The data are presented in tabular form. (ERB)

8159 GENERAL CRITERIA AND PRELIMINARY EXPERIMENTS IN STUDYING THE POSSIBILITY OF POLLUTION OF UNDERGROUND AND SURFACE WATERS BY RADIOACTIVE WASTE FROM A NUCLEAR REPROCESSING PLANT. Lenzi, G. (CNEN, Casaccia, Italy); Cassano, G. Ing. Sanit.; No. 1, 7-18(1972). (In Italian). (RT/PROT-(72)35).

The general criteria for study of radioactive contamination of underground waters in sites of nuclear fuel reprocessing are examined. As an example, the general situation of CRN of CNEN in Trisaia is studied, and the following arguments are described: stratigraphy and hydrogeology of the sites and analysis of representative soil samples for determination of distribution and dispersion coefficients. The hypothesis of ground water accidental contamination by 1000 Ci of fission products is considered and the dispersion in time and space is also calculated. (auth)

Water

8160 GEOCHEMICAL ASPECTS AND APPLICATIONS OF RADIONUCLIDES IN THE SEA. Duursma, E. K. (International Atomic Energy Agency, Monaco). Radioact. Sea; 10: No. 30, 137-223(1972).

This review is intended to update the geochemical part of the earlier review by Mauchline and Templeton (1964), published in this same annual review series. It covers the geochemical aspects of both artificial and natural radionuclides in the sea, and attention is paid to the use of radionuclides as tracers for sediment and water transport studies. The biological aspects of radionuclides in the marine environment will be reviewed in a separate article. The majority of the literature reviewed is that published since 1963 with some mention of relevant papers published earlier but not included in the review of Mauchline and Templeton (1964). (auth)

8161 (ANL-TRANS-943) ROLE OF ORGANIC MATERIALS IN A WATER COURSE WITH RESPECT TO RADIOACTIVE CONTAMINATION. Method of Extraction, Fractionation and Identification of Organic Constituents by Spectroscopy and their Affinity to Radionuclides. Faure, J. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Aug 1972. Translation of CEA-R-4335. 27p. Dep. NTIS $3.50.

The interactions of radionuclides (^{141}Ce, ^{133}Ba, ^{106}Ru, ^{137}Cs, ^{54}Mn, ^{65}Zn, ^{60}Co) with the organic matter extracted from a sediment were studied by extraction, fractionation, and nuclear techniques; these techniques were also applied to soil studies. The results indicate that the organic matter of the sediment under study was mainly constituted by substances of low molecular weights. Some very active groups of these substances (quinone and polycyclic hydroquinone) were observed using spectroscopic analysis methods in the ultraviolet and visible regions. (Fr)

8162 DETERMINATION OF THE DIFFUSION COEFFICIENT OF RADIOELEMENTS IN THE RHONE SEDIMENTS. Ijuin, M.; Picat, P.; Saas, A.; Grauby, A. (National Inst. of Radiological Sciences, Chiba, Japan). Health Phys.; 24: No. 6, 665-672(Jun 1973).

The transfer phenomena of ^{141}Ce, ^{60}Co, ^{137}Cs, ^{54}Mn, ^{85}Sr, and ^{65}Zn in the Rhone sediments were studied. The transfer of the various radioelements in the environment concerned obeys Fick's second law of diffusion. The diffusion coefficients (D) of ^{85}Sr and ^{54}Mn

were determined. They are respectively 2.1×10^{-2} cm^2/day and 1.1×10^{-2} cm^2/day. The values of the diffusion coefficients of the other elements were not determined accurately enough due to their fixation very near the sediment bed surface. However, they are expected to follow the same diffusion law according to the experimental procedure used. The stable elements in the Rhone sediments were analyzed by various spectrophotometric methods and by neutron activation. (auth)

8163 INCOMPLETE EXCHANGE REACTION BETWEEN RADIOACTIVE IONIC ZINC AND STABLE NATURAL ZINC IN SEAWATER. Piro, A. (CNEN–EURATOM, Italy); Bernhard, M.; Branica, M.; Verzi, M. pp 29–45 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

An apparatus which permits the simultaneous determination of stable and radioactive ionic zinc in aqueous solution is described. With this apparatus it is possible to investigate the exchange reactions between stable ionic and complexed zinc and radioactive ionic zinc in NaCl solution and seawater. In NaCl (34‰ S), in presence of a complexing agent, after about one hour the ^{65}Zn is distributed between the non-complexed and complexed fractions in the same way as the stable isotope, indicating a complete exchange reaction. On the other hand, adding ionic ^{65}Zn to seawater, the radioactive isotope is not uniformly distributed in all physicochemical states present in the seawater but it dilutes only in the ionic and particulated fractions. Even one year after the addition of ^{65}Zn the radioactive zinc has not entered the complexed fraction. The consequences of this fractionation for the interpretation of tracer experiments and hazard evaluation are discussed. (auth).

8164 PHYSICO-CHEMICAL BEHAVIOUR OF RADIOACTIVE CERIUM IN SEAWATER. Hirano, S.; Koyanagi, T.; Saiki, M. (National Inst. of Radiological Sciences, Nakaminato City, Japan). pp 47–55 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

An investigation has been carried out since 1969 on the nature of chemical species and existing states of radioactive cerium in seawater by means of filtration, ion-exchange, and solvent extraction with carrier-free ^{144}Ce as a tracer in pursuit of the physico-chemical behavior and its effect on biological concentration. From the results of the experiments it was concluded that: Radioactive cerium added into seawater exists mainly in dissolved forms and 20 to 25% of cerium becomes particulate forms having a diameter more than 0.01 μm after the aging for 40 days; Almost all of the radioactive cerium exists as ionic species in seawater or easily dissociates into ionic forms even after being associated with other anions present in seawater; although the ionic forms or easily dissociable species are the dominant existing states in the seawater with lowered pH below 6, radioactive cerium is hydrolyzed slowly when the pH is greater than 6 and forms complexes with hydroxide or chloride ions in seawater or changes to polymerized forms; and it was reported that the residence time of natural cerium in the sea is about 80 years and the forms of precipitation for natural cerium is CeO_2. Therefore, it is inferred that the equilibrium between natural cerium and radioactive cerium added in seawater is achieved after a considerable time. (auth)

8165 ADSORPTION-DESORPTION EQUILIBRIA OF SOME RADIONUCLIDES IN SEDIMENT-FRESHWATER AND SEDIMENT SEAWATER SYSTEMS. Murray, C. N.; Murray, L. (International Atomic Energy Agency, Monaco). pp 105–124 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 July 1972). See STI/PUB-313; CONF-720708-.

Knowledge of the behavior of radionuclides in estuarine environments is required in the understanding of their regulation in coastal areas. Experiments carried out to investigate the uptake of certain radionuclides on freshwater sediments in river water (adsorption) and their subsequent release from the sediments to the seawater (desorption) are described. For the radionuclides studied, ^{60m}Co, ^{65}Zn, ^{110m}Ag, their behavior was very individual. Laboratory results suggest that certain factors strongly affect the adsorption-desorption characteristics of the sediment. The influence of important factors such as the pH of the river, estuary, and seawater, the concentration of sediment and trace element in the river water, the speciation of the trace element, the mineralogy of sediment, the formation of particulate material in the river water and flocculation of this by sediment in the estuary and sea, and salinity effects on desorption, are discussed. From a knowledge of these factors, it is possible to predict, as a first approximation, for a given sediment the amount of radionuclide that will be taken up by a given weight of freshwater sediment in a very simple river system under equilibrium conditions. When this sediment reaches the marine environment the amount of desorbed radionuclide can be calculated. An example of a predictive calculation for adsorption-desorption of Vat river sediment is given for conditions of pH, sediment load, and tracer concentration that are typically found in this system. (auth)

8166 TRANSPORT AND DEPLETION OF RADIONUCLIDES IN THE COLUMBIA RIVER. Robertson, D. E.; Silker, W. B.; Langford, J. C.; Petersen, M. R.; Perkins, R. W. (Battelle Pacific Northwest Labs., Richland, WA). pp 141–158 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

The radionuclide transport and depletion processes in the Columbia River are being characterized following the closure of the last of the Hanford plutonium production reactors in January, 1971. Radionuclide concentrations are periodically being measured in river water, sediments, and biota between Hanford and Bonneville Dam to determine the rates and mechanisms of the processes that govern the distribution and behavior of the radionuclides in the Columbia River system. All the short-lived radionuclides in the river have now decayed, but some residual long-lived radionuclides have remained, being associated mainly with sedimentary deposits in the reservoir behind McNary Dam. The most abundant radionuclides remaining in the river are ^{55}Fe, ^{65}Zn, ^{155}Eu, ^{60}Co, ^{152}Eu, ^{154}Eu, ^{54}Mn, and ^{46}Sc. Also present in much lower concentrations are ^{125}Sb, ^{137}Cs, ^{144}Ce, and ^{239}Pu. These radionuclides are tightly bound to the sediments and enter the river mainly by resuspension, especially during the high river flow in the spring and early summer. The depth distributions of radionuclides in sediment cores collected at various locations in the reservoirs behind McNary. The Dalles, and Bonneville dams are being measured to estimate radionuclide inventories, sediment resuspension and transport, and sedimentation rates in the river system. Because present concentrations of radionuclides in the river water are low, large volume water sampling (up to 1000 litres) is required and is being done at the four dam sites downstream from Hanford to determine radionuclide concentrations, physicochemical forms, and transport in the river. Over 98% of the Columbia River radionuclides of Hanford origin that enter the river from bottom sediments are in particulate forms. The main mechanism for removing radioactivity from the river system other than by radioactive decay, is by scouring of surface sediments during high river flow, and their subsequent transport into the Pacific Ocean. The dissolution of sediment-attached Columbia River radionuclides on their entry into the marine environment is being studied by leaching Columbia River sediments with seawater. Since the net sediment deposition rate in the reservoir behind McNary Dam has, in the past, been greater than the scouring rate, it appears that eventually the major radioactive sediment deposits in the McNary reservoir will become covered by new, uncontaminated silt deposits. (auth)

8167 BEHAVIOUR AND DISTRIBUTION OF RADIOACTIVE SUBSTANCES IN COASTAL AND ESTUARINE WATERS. Nishiwaki, Y.; Honda, Y.; Kimura, Y.; Morishima, H.; Koga, T.; Miyaguchi, Y.; Kawai, H. (Kinki Univ., Osaka). pp 177–193 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

To understand the problems of environmental radioactive contamination due to continuous discharge of low-level liquid radioactive waste into the seawater, a study must be made of the behavior and distribution of various nuclides that may occur in both ionic and colloidal or particulate state in coastal and estuarine waters. However, the behavior and distribution of the various radionuclides in the estuarine water are much more complicated than those in the open sea, because of the complex topographical and marine meteorological variations and the changes in salinities and pH of the water. Since thorium and rare earth elements had been continuously discharged through a small river into the estuarine water at Osaka Bay, a study was made of the variation of concentration of these elements under various natural conditions. Experimental studies on adsorption of these elements on some bottom sediments were also carried out in the water with different salinities and pH. One important factor influencing the concentration of the elements in the water is tidal oscillation. The gross beta ac-

tivities in water at the same location in the estuary widely varied at each time of sampling. The average values from April to December in 1966 were 9.5 ± 4.9 pCi/litre at higher tidal level, 84 ± 68 pCi/litre at middle tidal level, and 157 ± 106 pCi/litre at lower tidal level respectively. However, the concentrations of thorium and total rare earth elements in the water were not observed to change regularly with the tidal change. The dispersion of the elements in the estuarine water were not interpreted by simple dilution and diffusion of the element in water mass. The presence of the mud flats, as well as the marine meteorological conditions, seemed to affect markedly the distribution of the element in the estuarine water. The adsorption of the element on the bottom sediment was influenced not only by the coarseness of the sediment but also by the salinity and pH of the water. The higher distribution coefficients of ^{91}Y and ^{144}Ce in the clay sediment were obtained at the chlorosity of 14 g/litre and pH 7.3 of the water. (auth)

8168 TRANSPORT OF RADIONUCLIDES IN LAKE AND RIVER SYSTEMS FLOWING THROUGH AREAS CHARACTERIZED BY PRECAMBRIAN BEDROCK AND PEAT-BOGS. Salo, A. (Inst. for Radiation Physics, Helsinki); Voipio, A. pp 195-217 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Strontium-90 and cesium-137 were determined together with the discharge (m^3/s) and the following stable chemical components: conductivity, pH, color, turbidity, HCO_3^-, PO_4-P, total-P, NO_3-N, NH_3-N, total-N, SiO_3-Si, SO_4-S, chloride, iron, aluminium, manganese, copper, zinc, sodium, potassium, magnesium, and calcium in two lake and river systems discharging into the Bothnian Bay (Baltic Sea) in 1965 to 1970. The water samples were taken monthly at one sampling station in the smaller (1330 km^2) and at five stations in the larger (14,315 km^2) lake and river system. Deposition was collected at three stations. The ratio was calculated of the deposited amounts to the amounts that are transported concerning the above-mentioned radionuclides and some stable components in both the catchment areas and the sub-regions of the lake and river systems. A factor analysis was used in an attempt to find the main factors affecting the behavior of the different chemical components, especially that of the radionuclides strontium-90 and cesium-137. When interpreting the results of the factor analysis, the chemical factors, the quality of the ground, hydrological features, and other possible environmental factors were taken into consideration. The regional differences are discussed. Special attention was paid to the annual changes in the factors affecting the behavior of strontium-90 and cesium-137. The most obvious factors determining the systems are those determining the behavior of the main electrolytes (Mg^{2+}, Na^+, K^+, Ca^{2+}, SiO_3-Si, HCO_3^-, Cl^-). All these components have good correlations to the discharge (contact time with the ground?); The factor common to those variables showed annual variations in their deposition in the catchment areas of strontium-90. A group of factors reflecting the quality of the soil, eventually characterized by the organic (younger) and inorganic (older) constituents of the soil also showed an effect. (auth)

8169 PHYSICO-CHEMICAL CHARACTERISTICS OF FIVE RUTHENIUM SALTS DURING FRESHWATER TO MARINE TRANSITION. Peperstraete, H.; Vos, J.; van Puymbroeck, S.; Vanderborght, O. (SCK/CEN, Mol. Belg.). pp 219-222 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

The changes in physico-chemical characteristics such as mobility in high-voltage electrophoresis, of different Ru-salts in solution are considered during their transition from freshwater to marine conditions. The biological availability for some indicator organisms is also assessed under the same controlled laboratory conditions. The five ruthenium salts studied: Nitrosylhydroxynitrite $Na_2[RuNO(NO_2)_4OH]2H_2O$; Nitrosylchloride $RuNOCl_3(H_2O)_2$; Chloride $RuCl_3 \cdot xH_2O$; Nitrosylnitrate complexes $RuNO(NO_3)_x \cdot H_2O_{5-x}$; and Nitrosylhydroxide $RuNO(OH)_3\ (H_2O)_2$. (auth)

8170 BIOLOGICAL AND PHYSICO-CHEMICAL ASPECTS OF THE RADIOCONTAMINATION OF MARINE SPECIES AND SEDIMENTS. Ancellin, J.; Avargues, M.; Bovard, P.; Gueguentiat, P.; Vilquin, A. (CEN, Fontenay-aux-Roses, France). pp 225-243 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973). (In French).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Various aspects of the physico-chemical and biological fate of radioactive pollutants in the marine environment are reviewed in the light of the results of recent radioecological research. In studying contamination of any kind, it is necessary to take into account the relative importance of physico-chemical and biological processes that take place simultaneously. In a certain number of cases the mechanisms whereby elements present in small quantities in seawater are adsorbed on to living organisms are similar to those that apply to inert bodies. The contribution of the species to fixation of the element is passive, and the physico-chemical properties of the contaminants and of the contaminated carrier can dominate its own biological properties, particularly the physiological barrier of regulation. Various types of equilibration of the pollution of the organs, notably in fish, with the pollution of the environment are examined, together with the differences in the capability of various competing sites for adsorption of a specific pollutant, for example, the capability of sediments or/and living species in contact with the sediments to take up transport ^{65}Zn, ^{60}Co, ^{131}I, ^{144}Ce, ^{106}Ru, ^{137}Cs, ^{54}Mn, ^{55}Fe, and ^{85}Sr. (auth)

8171 RADIOECOLOGY OF BENTHIC FISHES OFF OREGON. Pearcy, W. G.; Vanderploeg, H. A. (Oregon State Univ., Corvallis). pp 245-261 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Gamma-emitting radionuclides were found in benthic fishes from depths of 500 to 2800 m off the Oregon coast from 1964 to 1971; ^{65}Zn, ^{60}Co, ^{54}Mn, ^{144}Ce, ^{137}Cs, and ^{40}K were present. Zinc-65, originating mainly from the nuclear reactors on the Columbia River, was the predominant artificially induced radionuclide. Levels of ^{65}Zn per gram and specific activities of ^{65}Zn decreased markedly in several species of fishes between 1965 and 1971 because of the shutdown of reactors. This decrease was greater for small than for large Lyopsetta exilis during 1970 to 1971. Specific activities decreased with increasing depth, both for individual species inhabiting broad ranges and for different species inhabiting different depths. Specific activities of ^{65}Zn were inversely related to body size for L. exilis and Sebastolobus. Other variations of ^{65}Zn were related to trophic position. Fishes that preyed on low trophic level pelagic animals had higher specific activities than fishes that preyed on benthic invertebrates. Such pelagic feeders may play an important role in accelerating the transport of some radionuclides or elements to the sea floor. (auth)

8172 ZINC-65 SPECIFIC ACTIVITIES FROM OREGON AND WASHINGTON CONTINENTAL SHELF SEDIMENTS AND BENTHIC INVERTEBRATE FAUNA. Carey, A. G. Jr.; Cutshall, N. H. (Oregon State Univ., Corvallis). pp 287-305 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Relationships between the benthic invertebrate fauna and sediments on the continental shelf of Oregon and Washington were investigated by determining specific activities of ^{65}Zn. Zinc-65, induced by neutron activation in Columbia River water used to cool plutonium production reactors at Richland, Washington, was carried down the river and into the marine environment. Sediment from the Columbia River moves northward. Zinc-65 specific activities in sediment and benthic invertebrates decrease northward with distance from the river and westward with both distance and depth. Many organisms to the south of the river mouth and westward with depth have higher ^{65}Zn specific activities than the sediments in, or on, which they live. Other sources of ^{65}Zn via the food web are suspected as the cause for the difference in specific activity between the sediment and benthic fauna. Long-term declines in ^{65}Zn specific activities were noted. Many species from a range of trophic levels were included in the study. (auth)

8173 RADIOECOLOGY OF CERTAIN MOLLUSCS IN INDIAN COASTAL WATERS. Patel, B.; Valanju, P. G.; Mulay, C. D.; Balani, M. C.; Patel, S. (Bhabha Atomic Research Centre, Bombay). pp 307-330 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Knowledge of the distribution patterns of stable elements in the marine biosphere is an essential prerequisite for understanding the problems of radioactive contamination of marine biota, especially as regards indicator species. The distribution of a few major and trace elements of metabolic significance in the sea-hare (Aplysia benedicti), which moves shorewards in coastal waters during colder months is discussed. Of the various tissues analyzed, the

hepatopancreas and intestine including the gut-content showed higher concentrations of Co, Fe, and Ni, whereas Fe was deposited in buccal mass. The bio-accumulation of Zn, Cu, Sr, and Ca in whole animal and various tissues is also discussed in relation to environment. The Aplysia benedicti population from Tarapur waters, which receive radioactive wastes (^{131}I, ^{137}Cs, ^{51}Cr, $^{58,60}Co$, ^{54}Mn, etc.) from a boiling-water reactor, was found to accumulate ^{58}Co and ^{60}Co in the soft tissues. Hepatopancreas and gut-content contained the highest concentration of radiocobalt. Iodine-131, on the other hand, was concentrated in horny internal shell, possibly as a means for disposal. The spawn chords of this species were also found to accumulate ^{131}I from the environment. This species could therefore be used as an indicator of radionuclides of cobalt, although its occurrence in nearshore waters is strictly seasonal. (auth)

8174 CHEMICAL BEHAVIOUR OF ^{106}Ru IN SEAWATER AND UPTAKE BY MARINE ORGANISMS. Ishikawa, M.; Sumiya, M.; Saiki, M. (National Inst. of Radiological Sciences, Chiba City, Japan). pp 359-367 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

The physico-chemical behavior of prepared ^{106}Ru chloro- and nitrosyl chloro-complex species were investigated by filter paper electrophoresis using 0.1N $NaClO_4$ as a supporting electrolyte. ^{106}Ru chloro-complexes (III,IV) in a seawater system were fractionated physico-chemically into at least four "anionic", one "neutral" and the one "cationic" species. The electrophoretic mobilities of fractionated ^{106}Ru species in seawater were found to be constant for the nitrosyl chloro-complexes (III) during the aging period from 2 to 240 h, but remarkable changes were observed on the electrophoretic patterns of ^{106}Ru chloro-complexes throughout the experimental periods. It appears, in both cases, that significant physico-chemical changes take place within the initial stage after addition of ^{106}Ru complexes. Biological uptake experiments in clams, Meretrix lamarcki, were carried out with electrochromatographically fractionated ionic species of ^{106}Ru nitrosyl chloro-complexes. The gill and mid-gut gland (liver) showed high concentrations for all the fractionated species. Considerable differences of concentration factors (concentration ratio) of Ru by clams were observed in the anionic, cationic and neutral species, i.e., the concentration factor of the cationic fraction was 10 times higher than that of the other fractions. The order of the concentration factor was as follows: "catonic" ≫ "neutral" ≥ "anionic" species. (auth)

8175 EVALUATION OF PUBLIC RADIATION EXPOSURE FROM THE CONTROLLED MARINE DISPOSAL OF RADIOACTIVE WASTE (WITH SPECIAL REFERENCE TO THE UNITED KINGDOM). Preston, A.; Mitchell, N. T. (Fisheries Radiobiological Lab., Lowestoft, Eng.). pp 575-593 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Application of critical path techniques to the evaluation of public radiation exposure from the controlled marine disposal of radioactive waste is discussed. The discussion relates exclusively to the situation in the United Kingdom since critical path techniques have been more extensively applied there and because there is a dearth of published information on which to base reliable estimates of radiation dose commitment for other situations. The principal sources of radioactive waste at this time are nuclear power programs and especially at the stage at which fuel is reprocessed. In the United Kingdom, low-level liquid radioactive wastes from these programs are dispensed in surface waters and inshore marine environment. The origin and nature of such of these disposals that are made to estuaries and the sea are briefly summarized and the method of control is outlined. Each of the three basic principles of United Kingdom waste disposal policy is directly concerned with the limitation of public radiation exposure, and together they take account of both somatic and genetic doses. Discharges are controlled so that these principles are met, and the way in which this is achieved is illustrated by reference to methods employed in evaluating discharge limits in the different conditions posed before and after commencement of operation at a site. Since direct estimates of individual radiation exposure are very rarely possible, consumption/habits surveys occupy an essential role in control at all stages of pre- and post-operation. These surveys provide both qualitative information to identify the nature of exposure pathways and associated exposed population groups, and quantitative data of consumption and occupancy rates from which critically exposed groups can be recognized and their radiation exposure estimated. In addition to data from such surveys, detailed information from monitoring programs on critical materials must also be available to enable estimates of public radiation exposure to be made. This may be done by means of derived working limits, whose derivation and use are discussed. A review is presented of the current situation posed by some of the more important routine marine waste disposals in the United Kingdom, including estimates of public radiation exposure from examples taken from nuclear power generation and fuel reprocessing. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 8426, 8508, 8517–8519, 8524, and 8525.

8176 (CONF-700124-, pp 35-106) ENVIRONMENTAL RADIOACTIVITY. Fabrikant, J. I. (Johns Hopkins Univ. and Hospital, Baltimore). 1 Nov 1970.

From environmental radioactivity symposium; Baltimore, Maryland, USA (19 Jan 1970).

In environmental radioactivity symposium.

Radiation exposure from natural and man-made sources, the mechanisms by which radioelements can find their way into tissues and cells of human bodies, the effects they may cause there, and the relation of radiation exposure to the health of human populations are discussed. Data from cellular studies are reviewed that lead to the conclusion that any exposure to radiation carries some risk of deleterious effects. Somatic effects become manifest in the exposed individual as leukemia and other cancers, and genetic or hereditary effects affect his descendants. Radiation, when it involves the public health, becomes a sociological and political problem possibly to be decided by men of business and law, and not just an exercise in statistical theory or laws of chance. In an evaluation of the risks from radiation, it is necessary to limit the radiation dose to a level at which the risk is acceptable, both to the individual and to his society, if he wishes to continue to derive benefits from such activities. (CH)

8177 (CONF-700124-, pp 107-180) RADIOECOLOGY. Rice, T. R.; Baptist, J. P. (Bureau of Commercial Fisheries, Beaufort, NC.). 1 Nov 1970.

From environmental radioactivity symposium; Baltimore, Maryland, USA (19 Jan 1970).

In environmental radioactivity symposium.

Radioactive elements also have proven particularly useful in studies of marine ecosystems, including the use of ^{14}C for measurements of the amounts of carbon fixed by photosynthesis in marine plants, the movement of elements in the environment, food requirements and utilization by marine animals, and tagging of marine organisms and sediments so that their movement can be followed. The principal source of man-made radioactivity in the environment to date has been fallout from atomic test explosions. On the other hand, wastes will be an increasing source of radioactivity as there is increased use of radioisotopes in clinical and experimental research applications and increased use of nuclear reactors in power plants and ships, including submarines. Artificially produced radionuclides in the aquatic environment consist of fission products and induced radionuclides. Those that have been identified in the sea include ^{89}Sr, ^{90}Sr, ^{90}Y, ^{91}Y, ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{106}Ru, ^{103m}Rh, ^{106}Rh, ^{129m}Te, ^{129}Te, ^{129}I, ^{137}Co, ^{137m}Ba, ^{141}Ce, ^{144}Ce, ^{144}Pr, ^{144}Nd, ^{147}Pm, ^{147}Sm, ^{131}I, ^{140}Ba, ^{32}P, ^{35}S, ^{51}Cr, ^{54}Mn, ^{55}Fe, ^{59}Fe, ^{57}Co, ^{58}Co, ^{60}Co, ^{65}Zn, and ^{113m}Cd. The cycling of these radionuclides in marine environments and concentrations found in marine plants and animals are reviewed. Applications of the data in research studies on the marine environment to provide a basis for predicting the effects of increased levels of radioactivity on the environment are discussed. (CH)

8178 UMWELTSCHUTZ. Das umweltprogramm der bundesregierung. (Environmental protection. The environmental program of the Federal Government). Stuttgart; Kohlhammer (1972). 199p.

The Federal Program for environmental protection is published as a pocket book. It contains a preface written by the Federal Minister for Internal Affairs, H. D. Genscher, and is divided into two parts, one on environmental policy in general and the other on the program itself. (GE)

8179 ROLE OF VERTEBRATES IN THE UPTAKE AND LOSS OF RADIOISOTOPES. Bernhard, M. (CNEN-EURATOM, La Spezia, Italy). Rev. Int. Oceanogr. Med.; 20: 101-123(1970). (RT/BIO-(72)57).

The importance of fishery products in human diet is discussed using data published by FAO. These data show an increase in terrestrial food and a decrease in fish food on a per capita basis. A comparison between the Concentration Factor and the Specific Activity approach for the prediction of the degree of radiocontamination in marine organisms shows that it is more useful to

use the Concentration Factor approach for non-regulated elements and the Specific Activity approach for regulated elements. The consideration of different physicochemical forms in the Specific Activity approach increases its precision. Finally the few data available on the uptake of radioisotopes by marine vertebrates are discussed. (auth)

8180 EVALUATION OF THE RISKS RELATED TO THE DISCHARGE OF RADIOACTIVE ISOTOPES IN A MARINE ECOSYSTEM. I. A comparison between the concentration factor approach and the specific activity approach. Bernhard, M. (CNEN-EURATOM, La Spezia, Italy). Rev. Int. Oceanogr. Med.; 20: 125-131(1970). (RT/BIO-(72)58).

Data are given on the radioecology of marine and coastal waters. A comparison is made between the Concentration Factor and the Specific Activity approaches to determining the radioisotope contents in components of these regions. Given sufficient data, and taking into account the physicochemical forms of the radioisotopes present, both methods should yield the same values. (ERB)

8181 REMOVAL OF FISSION PRODUCTS FROM MILK. The Use Of The Baby Monkey (Macaca irus) For The Nutritional Evaluation of Milk Treated By Two Processes. Cohen, B.; Ashworth, M.; Glascock, R. F.; Bryant, D. T. W. (Royal Coll. of Surgeons of England, London). J. Dairy Res.; 40: No. 1, 53-61(Feb 1973).

The nutritional quality of milk treated by two previously described processes for the removal of cationic fission products was evaluated by the use of the baby monkey (Macaca irus). The first process involves acidification of the milk to pH 5.2 to 5.3 and, when the treated milk was tested on baby monkeys, it was found to be nutritionally unsatisfactory. This result confirmed those previously obtained with baby pigs, from which it was concluded that the process cannot be recommended for the treatment of milk intended for young babies. Two resin beds are used in the second process and no acidification is involved. Milk treated by this process was first tested on baby rats and pigs and then on baby monkeys. No change in the nutritional value of the milk was detected and it was concluded that this is the process that should be used if it should ever become necessary to remove fission products from milk intended for young babies. (auth)

8182 EXPERIENCE OF THE CENTRAL ELECTRICITY GENERATING BOARD IN MONITORING THE ENVIRONMENT OF ITS NUCLEAR POWER STATIONS. Jones, J. K.; Lewis, G.; Orchard, H. C.; Owers, M. J.; Skelcher, B. W. (Central Electricity Generating Board, London). Health Phys.; 24: No. 6, 619-625(Jun 1973).

The Central Electricity Generating Board has been monitoring the environment of civil nuclear power reactors since 1957. The history of the monitoring program is described, and the modifications that have resulted from operational experience are discussed together with those required as a result of amendments to the legislation affecting environmental surveys. The "tackishade" device, developed for detecting airborne radioactivity, is described. (auth)

8183 CONTENT OF SOME TRACE ELEMENTS AND NATURAL RADIOACTIVITY IN FOOD IN RELATION TO THE PROBLEM OF ENDEMIC GOITER. Mikhalyuk, I. A.; Motuzkov, I. N. Vop. Ratsion. Pitan.; 6: 85-89(1970). (In Russian).

Data are given on the content of V, Pb, Cr, and natural radioactivity in the food products of areas of Kiev Oblast which are goiter-free and which have endemic goiter. There is a high content of V and Cr and a lack of Pb in individual foods and diets in an area with endemic goiter. The radioactivity of the food products of both areas corresponded to the level of natural radioactivity caused by ^{40}K and did not differ materially. (EURATOM)

8184 LEVELS OF RADIOACTIVITY IN THE MARINE ENVIRONMENT AND THE DOSE COMMITMENT TO MARINE ORGANISMS. Woodhead, D. S. (Fisheries Radiobiological Lab., Lowestoft, Eng.). pp 499-525 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Published data on the levels of radioactivity in seawater, the sea bed and marine biota from natural sources, fallout, and waste-disposal operations, are reviewed. As a starting point for calculations of dose-rates to marine organisms the data have several deficiencies. First, a complete set of data for all the isotopes (natural and artificial) is not available for either a single species or even for groups of organisms. It was found convenient therefore to summarize the data in terms of the following groups of organisms: phytoplankton, zooplankton, mollusca, crustacea, and fish. Secondly, within the groups of organisms the data refer to widely differing or unknown geometries, and there is little information on the differential distributions within organisms. Therefore, to calculate the dose-rates, simple idealized models were employed to represent each of the five groups, despite their obvious limitations as a description of the real situation. Within the limitations imposed by the data and the dosimetry models, the results of the calculations show that, in a global context, the dose-rates to marine biota from artificial radionuclides are of the same order as those from natural background sources, and that weapons-test fallout is the major contributor. The practice of marine disposal of radioactive waste leads to locally high dose-rates, but in population or global terms the dose-rate contribution is and will probably remain negligible. (auth)

8185 MUSSELS AND BARNACLES AS INDICATORS OF THE VARIATION OF ^{54}Mn, ^{60}Co, AND ^{65}Zn IN THE MARINE ENVIRONMENT. Young, D. R. (Southern California Coastal Water Research Project, Los Angeles); Folsom, T. R. pp 633-650 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

The intertidal byssal mussel Mytilus californianus and the oceanic gooseneck barnacle Lepas anatifera are efficient indicators of spatial and temporal changes in levels of three radiometals in the marine environment. Lepas specimens collected from the northeastern Pacific during the first half of 1964 demonstrated oceanic-to-coastal ratios of ^{54}Mn, ^{60}Co, and ^{65}Zn fallout from the 1961-62 thermonuclear tests of approximately 3 : 1, 4 : 1, and 2 : 1, respectively. Cesium-137 in the surface layers of the two sectors (whose centers lie about 1500 and 300 km west of San Diego) also showed a 3 : 1 oceanic-to-coastal enhancement of fallout from this source. Mytilus specimens collected during 1963-64 along the northeastern Pacific Coast showed a fairly uniform distribution of ^{54}Mn and ^{60}Co between latitudes 46 and 29° north, but dramatically reflected the point source of Hanford-produced ^{65}Zn emanating from the mouth of the Columbia River. Relatively high zinc-65 concentrations, possibly related to this source, were detected in Mytilus from northern Baja California, Mexico, 1900 km to the south. Except for a late 1963 peak in ^{54}Mn concentrations in southern California Mytilus, the ecological half-times of the three nuclides observed in the invertebrates between mid-1963 and late 1964 at specific intertidal, coastal, and oceanic platforms were consistent with radioactive decay rates. This suggests an approximate equilibrium between input and removal of these radiometals in the mixed layer. Mussel and barnacle tissue-to-seawater enrichment factors for the three nuclides exceed 1000. In Mytilus 4 to 6 cm in length, size variations had no significant effect on nuclide concentration, but 70% of the ^{60}Co and ^{65}Zn soft-tissue radioactivity was located in the kidneys and digestive glands of this organism. Bay mussles (M. edulis) taken from the coastal surf zone showed concentrations similar to those in M. californianus, but M. edulis in two nearby bays had lower values. Intertidal coastal mussles and gooseneck barnacles recently collected from 14 California stations indicate average 1971 baseline concentrations of ^{54}Mn, ^{60}Co, and ^{65}Zn of 0 to 5, 0 to 4, and 0 to 11 pCi/wet kg, respectively. (auth)

8186 ANOMALOUS $^{228}Th/^{232}Th$ AND $^{230}Th/^{232}Th$ ACTIVITY RATIOS IN BACKWATER SEDIMENTS ALONG THE WEST COAST OF INDIA. Joshi, L. U.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay). pp 747-755 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Recently, remarkable disequilibrium between naturally-occurring ^{228}Th and ^{232}Th activities was observed in the top layer sediments of the backwaters along the Indian Coast. The $^{228}Th/^{232}Th$ activity ratios in Bombay harbor region (19°N, 73°E) and Kerala belt (8°–10°N, 76°–77°E) were found to be in the range of 0.55 to 0.67, while this ratio is in the range of 2.00 to 2.19 along the rest of the West Coast of India between Bombay and Kerala region (19°–15°E, 76°–77°E). The ^{230}Th and ^{232}Th activities also show anomalous behavior in these regions. The $^{230}Th/^{232}Th$ activity ratio in the Bombay region is about 0.133, while the ratio lies between 0.23 to 0.25 in Kerala belt. The coastal region between Bombay and Kerala, the ratio lies in the range of 0.95 to 1.07. The variation in the $^{228}Th/^{232}Th$ activity ratio is attributed to preferential leaching of ^{228}Ra by water flowing over the sediments. $^{230}Th/^{232}Th$ activity ratio is governed by the ^{230}Th activity in waters adjacent to the sediments. In the dynamic processes in marine environment, the sediment and the water interface are the most important and equilibria are expected to be established only among the chemical species occurring at the surface of the sediment and the ambient medium. A geochemical study of these sediments is being

carried out by leaching the samples with 5% EDTA at pH 3.00 in order to investigate the processes occurring on the surface and the distribution of natural thorium isotopes in backwater sediments. (auth)

8187 RADIOACTIVE SUBSTANCES IN LAKE ZEGRZYNSKIE. Dojlido, J. Pr. Inst. Gospod. Wodnej; 5: No. 4, 111-146(1969). (In Polish).

Tabulated and graphical results are given of studies on the beta activity of water, seston, periphyton, aquatic plants, bottom sediments, and fish in lake Zegrzyńskie, Poland, in 1963 and 1964. The greatest amount of radioactivity in the water in both years was detected in the spring and was associated with the occurrence of more intense precipitation and flood waves. In general, however, the activity was lower in 1964 than in 1963 owing to cessation of atmospheric atomic tests. Of the aquatic organisms investigated, seston accumulated the most activity and fish the least. (auth)

8188 ACIDITY OF PASTURE SOIL AND ACCUMULATION OF STRONTIUM-90 IN THE GRASS, SKELETON OF CATTLE, AND IN THEIR MILK. Shindel'man, Yu. M. Latv. Lauksaimn. Akad. Raksti; No. 22, 182-184(1969). (In Russian).

The effects of soil acidity on the accumulation of ^{90}Sr in grass, in the ribs of cattle, and in milk were determined. At pH values of 5.4 and 4.9, respectively, the ^{90}Sr content of grass was 1.9 and 3.7; of ribs 1.5 and 1.9; and of milk 1.4 and 2.2 times as high as for soil at pH 6.4. No absolute values were given. The additions of lime to acid soil improved growth and decreased the ^{90}Sr content in grass and animals. (ERB)

8189 HYGIENIC PROBLEMS OF ^{90}Sr AND ^{137}Cs MIGRATION ALONG THE CHAIN SOIL-PLANTS-MILK AND BEEF. Dauskurdis, S. I.; Novikov, Yu. V. Gig. Sanit.; No. 4, 91-94(Apr 1973). (In Russian).

The uptake of ^{90}Sr by fodder plants from the soil was determined in relation to the type and pH of soil, type of fodder (hay, straw, and grass), and the quantity of ^{90}Sr found in each type of fodder. Average ^{90}Sr and ^{137}Cs contents in beef and milk are shown graphically for the years 1965 through 1969 and discussed. (KSW)

Radiometric Techniques

Refer also to abstracts 7887, 8141, 8160, and 8166.

8190 (AD-753570) ELECTRON MICROPROBE ANALYSIS OF FALLOUT PARTICLES FROM FOUR UNITED STATES NUCLEAR DETONATIONS. Runquist, A. W.; Benck, R. F.; Crisco, C. (Ballistic Research Labs., Aberdeen Proving Ground, MD). Sep 1972. Contract AT(49-7)-2883. 77p. (BRL-1611). NTIS.

An investigative study of the processes and mechanisms of radioactive fallout particle formation has been underway since 1964. As part of this program, radioactive fallout particles from U. S. nuclear detonations were analyzed on a microscale in order to determine the chemical relationship between the nonradioactive matrix and the radioactive components of the particles. Analyses of 27 particles from Shots Tewa, Navajo, Sedan, and Johnie Boy are discussed. (auth)

8191 (RLO-2225-T-24-14) COLUMBIA RIVER EFFECTS IN THE NORTHEAST PACIFIC: CHEMICAL AND GEOLOGICAL STUDIES. Progress Report, May 1972–May 1973. Carpenter, R. (Washington Univ., Seattle. Dept. of Oceanography). May 1973. Contract AT(45-1)-2225-T24. 17p. Dep. NTIS $3.00.

Sedimentation rates of the Northeast Pacific continental shelf and slope adjacent to the point of inflow of the Columbia River during approximately the past hundred years were measured using radiometric analysis of naturally occurring ^{210}Pb and ^{210}Po and ^{14}C dating of drill core samples from various locations and depths. The results showed that Columbia River sediments do not accumulate uniformly over the shelf or move uniformly over the shelf break and downslope. An attempt was made to find Hanford-derived radionuclides in surface sediments but no ^{60}Co or ^{65}Zn was detected. The effects of the salinity of the seawater mixing zone on the diffusion of Columbia River fluorine and mercury were also studied. (CH)

8192 PULSE NEUTRON GENERATOR FOR HYDROGEOLOGICAL WELL LOGGING. Brzezinski, M.; Chrusciel, E.; Massalski, J. M.; Morstin, K.; Starzec, A.; Wanic, J. (Inst. of Nuclear Techniques, Krakow). Geofiz. Geol. Naft.; No. 1-2, 31-38(1971). (In Polish).

The first borehole measurements made by means of the pulsed neutron generator constructed in the Institute of Nuclear Techniques in Kraków are discussed. Information about the downhole probe and surface equipment is given at the beginning, and the principles of several pulsed neutron logging methods are described. The results of pulsed neutron–gamma logging (for which the concerned apparatus was provided) in some hydrogeological wellbores, are presented. An attempt at the qualitative and quantitative interpretation of these results (determination of lithological boundaries, evaluation of porosity of water-bearing layers) has been done. Conclusions for the next measurements to be done in oil and gas wells are established. (auth)

8193 RADIOMETRIC TRAVERSE OF THE SEABED OFF THE YORKSHIRE COAST. Miller, J. M. (Inst. of Geological Sciences, London); Symons, G. D. Nature (London); 242: No. 5394, 184-186 (16 Mar 1973).

A towed seabed γ spectrometer was used to obtain continuous profiles of the natural radioactivity of rocks and sediments on the sea floor. Total count, K, U, and Th measurements were made to investigate the possibility of using this technique to map the solid and drift geology. The seabed instrumentation comprised a NaI(Tl) scintillation detector and EHT unit shock mounted in a stainless steel probe, and the shipboard installation was based on four channel Harwell 2000 series electronics, the channel outputs being recorded in both analogue and digital forms. Preliminary sea trials were carried out on MV Surveyor around northern Britain between August and October 1971, and included a traverse along the 30 fathom line off the Yorkshire coast. A reasonable fit was obtained between the geology and the radiometry, although there were some discrepancies. Results are shown graphically. Detailed evaluation of the pattern of γ activity and a better understanding of the significance of the finer details of the results must await a further and more systematic survey of the area, but the results suggest that radiometric techniques offer a valuable new means of extending knowledge of both the solid and drift geology of the sea floor. (UK)

8194 NON-EQUILIBRIUM ISOTOPIC FRACTIONATION BETWEEN SEAWATER AND PLANKTONIC FORAMINIFERAL TESTS. Shackleton, N. J. (Cambridge Univ., Eng.); Wiseman, J. D. H.; Buckley, H. A. Nature (London); 242: No. 5394, 177-179 (16 Mar 1973).

It has been suggested that the temperature dependence of the isotopic fractionation factor between the oxygen in water and that in $CaCO_3$ could be used as a geological thermometer, and for estimating Earth surface temperatures biologically deposited $CaCO_3$ is more widely available than inorganic precipitates. It was necessary to find whether organisms deposit carbonate under equilibrium conditions, and in the case of molluscs it was found that they deposit carbonate in isotopic equilibrium with the surrounding water. Until recently ir had been assumed that this was also true for Foraminifera, but it is now found that this was an unwarranted assumption. Difficulties in translating foraminifera data to temperature scales are discussed, and it is concluded that it is not possible to translate the data into equivalent temperatures on the basis of thermodynamic principles alone. In some manner yet to be determined the organisms deposit carbonate of isotopic composition differing slightly from the thermodynamically predicted value. Some oxygen isotope analyses are described and implications for depth habitat studies and for palaeotemperature studies are discussed. Deviations are species dependent. (UK)

Site Surveys

Refer also to abstracts 8141, 8191, 10365, 10397, 10453, and 10462.

8195 (DOCKET-701257-4) URANIUM OXIDE FUEL PLANT. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). May 1973. 82p. Dep. NTIS $6.25.

The draft environmental statement for Exxon Nuclear Company's uranium oxide fuel plant is presented that considers the ecological impact and storage of liquid process wastes and lists alternatives that were considered. (DHM)

8196 (USGS-474-162) ELECTRICAL DISPERSION CHARACTERISTICS OF SELECTED ROCK AND SOIL SAMPLES FROM THE NEVADA TEST SITE. Eberle, W. R.; Bigelow, R. C. (Geological Survey, Denver, Colo.). Jun 1973. Contract AT(29-2)-474. 56p. Dep. NTIS $5.45.

Laboratory measurements of the resistivity and dielectric constant of alluvium soils, tuffs, rhyolite, and other rock types (total, 17 samples) from the Nevada Test Site were made at decade intervals of frequency from 100 Hz to 100 MHz. Water contents ranged from 0.3 percent by volume for a partially saturated dolomite to 30.9 percent by weight for a fully saturated tuff. Low-frequency (100 hz) resistivity ranged from 31.4 ohm-meters for a saturated tuff to 22,600 ohm-meters for a partially saturated granite. High-frequency (100 MHz) resistivity ranged from 10.9 ohm-meters for a saturated tuff to 533 ohm-meters for a partially saturated dolomite. Low-frequency (100 Hz) relative dielectric

constant ranged from 200 for a partially saturated dolomite to 88,300 for a saturated tuff. High-frequency (100 MHz) dielectric constant ranged from 6.25 for a partially saturated granite to 26.4 for a saturated tuff. (auth)

8197 (USGS-474-164) BIBLIOGRAPHY OF PUBLISHED REPORTS BY U. S. GEOLOGICAL SURVEY PERSONNEL ON THE GEOLOGY AND HYDROLOGY OF THE AMCHITKA SUPPLEMENTARY TEST AREA, ALEUTIAN ISLANDS, ALASKA, 1969–1972. Ohl, J. P. (comp.) (Geological Survey, Denver, Colo.). Jun 1973. Contract AT(29-2)-474. 17p. Dep. NTIS $4.00.

8198 (USGS-474-165) BIBLIOGRAPHY OF PUBLISHED REPORTS BY U. S. GEOLOGICAL SURVEY PERSONNEL ON THE GEOLOGY AND HYDROLOGY OF THE CENTRAL NEVADA TEST AREA, NYE COUNTY, NEVADA, 1968–FIRST QUARTER 1973. Ohl, J. P. (comp.) (Geological Survey, Denver, Colo.). Jun 1973. Contract AT(29-2)-474. 13p. Dep. NTIS $4.00.

8199 ACCUMULATION OF CERTAIN TRACE ELEMENTS IN MARINE ORGANISMS FROM THE SEA AROUND THE CAPE OF GOOD HOPE. Van As, D.; Fourie, H. O.; Vleggaar, C. M. (Atomic Energy Board, Pelindaba, S. Afr.). pp 615-624 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

An investigation of the recipient capacity of the sea for radioactive effluent from a site on the west coast of South Africa, 25 km north of Cape Town, necessitated the determination of concentration factors for those nuclides that would probably be present in the effluent of the proposed nuclear installations. Stable element analyses were done for these corrosion elements, which are known to have high accumulation factors and which have induced radioactive isotopes of long half-lives, e.g., Cr, Fe, Zn, Co, Mn and Sb, as well as for the stable counterparts of the fission products ^{90}Sr and ^{137}Cs. Various methods of sample preparation, e.g., freeze drying, dry and wet ashing, and of sample analyses, e.g., atomic absorption and neutron activation, were used in parallel and the results compared. The marine organisms which are either regularly consumed or which may have future economic importance were investigated. These species included Algae (Poryphyra capensis, Ecklonia maxima, Ulva spp., Suhria Vitatte), Molluscs (Haliotis Midae, Donax serra, Mytilus meridionalis) and Crustacea (Jasus lalandii), as well as various line and pelagic fishes of commercial importance. Analyses were normally performed on the edible parts of the species only. With regard to coastal and off-shore waters, measurements of the soluble and particulate fractions of these elements were made and different techniques of sample storage and sample preparation, e.g., deep freezing and freeze-drying, were compared. (auth)

Thermal Effluents

8200 (BNWL-SA-4709) EFFECTS OF ACUTE COLD SHOCK ON THE CHANNEL CATFISH, ICTALURUS PUNCTATUS. Block, R. M. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. 15p. (CONF-730505-2). Dep. NTIS $3.00.

From thermal ecology symposium; Aiken, South Carolina, USA (3 May 1973).

Elevated temperatures in the region of cooling water outfalls may bring water temperatures closer to the optimum or preferred temperature of certain species of fish. This optimal temperature of the water may attract fish that would then become trapped in the cooling water discharge canals or mixing zones by metabolic acclimation to these higher levels of temperatures. Sharp temperature decreases may result during the winter months when artificial heating water suddenly ceases, producing large fish kills. Results are reported from a study on the physiological effects of cold temperature shock on a warm water fish. Channel catfish (Ictalurus punctatus) were used in the study. The effects of abrupt change of water temperature from 30°C to 10°C on the blood plasma levels of protein, chloride, and glucose, hematocrit, and osmolarity were determined at various times. No fish died during 24 hours at 10°C, however about one-fifth of the group died following readjustment of the temperature to 30°C. The data indicate that the response of the fish to cold shock was mediated by osmoregulatory collapse resulting from failure of nervous mechanisms that influence surface membrane permeability, renal function, and ion transport processes. This effect was reversible up to a point in time. (CH)

8201 (BNWL-SA-4712) PRELIMINARY STUDIES ON THE EFFECT OF FATIGUE ON THERMAL TOLERANCE OF RAINBOW TROUT, SALMO GAIRDNERI. Schneider, M. J.; Genoway, R. G.; Barraclough, S. A. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. 13p. (CONF-730505-3). Dep. NTIS $3.00.

From thermal ecology symposium; Aiken, South Carolina, USA (3 May 1973).

Preliminary studies on the combined effects of thermal stress and exercise fatigue on rainbow trout (Salmo gairdneri) are reported. Data are presented on the effects of thermal shock on the content of lactic acid and glucose in blood samples measured at intervals of five minutes following exposure to water temperature of 27°C for three minute intervals after acclimation at 12°C. Fluctuations in both glucose and lactic acid levels were observed that persisted for some time following thermal shock. (CH)

8202 (COO-2161-9) MICROBIOLOGY OF THERMALLY POLLUTED ENVIRONMENTS. Technical Progress Report. Brock, T. D. (Wisconsin Univ., Madison (USA). Dept. of Bacteriology). 1 Apr 1973. Contract AT(11-1)-2161. 47p. Dep. NTIS $4.50.

Results are reported from studies on the effects of thermal additions from the Yellowstone geyser basin on benthic algae of the Firehole River, Wyoming. Heating of the river led to increased populations of benthic algae. The algae adapted to the temperature of the water. There were distinct differences in algae types found in the heated and unheated parts of the river, with the main difference being a marked increase in filamentous green algae in the heated sections. Measurements of photosynthesis in the natural populations suggest that the additions of thermal water increase the algae standing crop through increases in growth rate of the algae, and that the algae are optimally adapted to the habitat. (CH)

Chemical Effluents

Refer also to abstracts 8124, 8141, and 8145.

8203 (BNWL-1651(Pt.1), pp 30-33) NATURAL PRECIPITATION WASHOUT OF SULFUR DIOXIDE. Dana, M. T.; Hales, J. M.; Wolf, M. A. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

A field investigation and a modeling effort are being conducted as components of an ongoing program for the study of sulfur-compound washout from power-plant plumes. The theoretical analysis of SO_2 washout developed in this work was shown to agree fairly well with field measurements of washout of SO_2 from controlled releases from towers. (auth)

8204 (UCRL-74249) ATMOSPHERIC MODELING AND ENVIRONMENTAL PROTECTION NEEDS. Knox, J. B. (California Univ., Livermore. Lawrence Livermore Lab.). 9 Oct 1972. 16p. (CONF-721002-3). Dep. NTIS $3.00.

From interagency conference on the environment; Livermore, California, USA (17 Oct 1972).

Results are reported from a survey of the atmospheric modeling capabilities of the National Laboratories pertinent to the key present-day environmental questions. The needs of the Environmental Protection Agency (EPA) for atmospheric modeling to provide a scientific basis for the improvement of ambient air quality and the operational use of regional air pollution models for the design and implementation of measures of control during air pollution episodes are briefly reviewed. The spatial scales of interest to EPA are stated to be the urban scale (1 to 25 km) and the local scale (10 to 1000 meters). The air quality models presently being developed calculate the transport and diffusion of passive and reactive pollutants assuming the required meteorological fields of horizontal wind, height of the mixed layer, horizontal and vertical eddy diffusivities are known or predicted on an appropriate scale. Simulation models designed for land use plan assessment or emission zoning considerations can be run from historical information on a regional scale, or from information from neighboring airport weather stations, whereas the operational use of air pollutant models in a truly predictive sense requires mesoscale meteorological predictive capability, or boundary layer predictive capability over mixed rural, suburban, and urban areas. The need for an adequate data base for the development of coupled hydrodynamical-reactive pollutant models with predicted meteorology and the subsequent model verification and application is emphasized. (CH)

8205 (WASH-1217) CHEMIST–METEOROLOGIST WORKSHOP, FT. LAUDERDALE, FLORIDA, JANUARY 1972. (Division of Biomedical and Environmental Research, Washington, D. C.). 1972. 64p. Dep. NTIS $5.45.

Summaries and recommendations are presented for the four panel discussions held at the second Fort Lauderdale workshop, the purpose of which was an exchange of ideas between chemists and meteorologists. Topics discussed by the four panels were: stratospheric trace substance sampling and measurement, the

cycle of gaseous and particulate trace substances in the atmosphere, atmospheric–hydrosphere interactions, and regional studies of atmospheric pollution from near-surface sources. (JGB)

8206 SORPTION-DESORPTION REACTIONS OF MERCURY WITH SUSPENDED MATTER IN THE COLUMBIA RIVER. Bothner, M. H.; Carpenter, R. (Univ. of Washington, Seattle). pp 73-87 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB–313; CONF-720708–.

The influence of Columbia River suspended matter on the fate of dissolved mercury in the river and during the transition from the river to the oceanic environment was investigated. The approach was to spike natural Columbia River water with ^{203}Hg-labeled mercuric nitrate and methyl mercury chloride under laboratory conditions and to follow the reactions of the radioactive species with the suspended matter during exposure to river water and to seawater. The concentrations of natural mercury in Columbia River water, its suspended matter, and bottom sediments were also determined. The partitioning of both natural and radioactive mercury species between the dissolved and suspended phases was very similar. Between 50 and 75% of the natural mercury and the added radioactive species was associated with the particulates. Both inorganic and methyl mercury are fairly rapidly taken up by the natural assemblage of Columbia River particulates. The desorption experiments show that at least half of each of these forms is fairly easily desorbed by filtered river water of lower total mercury content. Subsequent washes with seawater remove little additional mercury from the particulates during roughly one week contact time. (auth)

INSTRUMENTATION

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 9549, 9558, 9628, 10007, and 10208.

8207 (CONF-730321-1) EXPERIENCES WITH SEMICONDUCTORS IN IMAGING AND FUNCTION STUDIES AT VANDERBILT. Patton, J. A.; Brill, A. B.; Blanco, G.; Highfill, R. (Vanderbilt Univ., Nashville, Tenn.). 1973. Contract AT(40-1)-2401. 20p. Dep. NTIS $3.00.

From semiconductor detectors in medicine meeting; San Francisco, California, USA (8 Mar 1973).

Studies on Ge(Li) and Si(Li) detectors for counting, imaging, and x-ray fluorescence thyroid scanning are described. Topics include multiple radioisotope studies, thyroid fluorescence scanning, cardiac output, gall bladder studies, and transmission scanning. (WHK)

8208 (INS-TH-78) ON-LINE DATA PROCESSING SYSTEM FOR WIRE SPARK CHAMBER, 1. Readout Control. Inaba, S.; Kondo, K.; Yamamoto, A.; Sasao, N. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 7 Sep 1972. 29p. (In Japanese). NTIS (U.S. Sales Only).

Readout circuits for a wire spark chamber and the interface for a PDP-5 or -8 computer have been constructed. The system has been successfully used for a polarization measurement of the coherent bremsstrahlung. The system is designed so that it can be used both for the magnetic core and magnetostrictive readout of spark position. It is capable of digitizing 32 spark positions with an accuracy of 1 in 4096. The maximum number of sparks that can be handled in one coordinate is 4. The circuits are mostly composed of integrated circuits. A block diagram of the whole system is shown. It consists of core matrices, sense amplifiers, interval counters, shift registers, core drivers, a start-stop control and a PDP-interface. Up to the present, the system has been used for magnetic core readout. The spark positions stored in the cores are interrogated with 500 kHz frequency and are read out as a sequence of pulses through the sense signal line. The first core is set "1" by every event signal, giving a fiducial pulse. The time interval between each pulse and fiducial pulse which appear on the sense line is converted to a pulse train by gating clock pulses of 2 MHz and these gated clock pulses are sent to interface circuits. The interface has 32 × 12-bit counters and stores the number of the gated clock pulses. The contents of the 32 counters are fed into a PDP-5 or -8 in either program interrupt or data break mode. (auth)

8209 (IRI-132-73-2) DESIGN OF THE ELECTRICAL CIRCUITRY FOR A POSITION SENSITIVE HIGH RESISTANT ANODE WIRE ^{3}He NEUTRON DETECTOR. Ciftcioglu, O. (Interuniversitair Reactor Instituut, Delft (Netherlands)). May 1973. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

Electrical analysis of the position sensitive detector system was carried out. The system contains a radiation detector, electronic circuitry for the pulses obtained from the detector, and a coupling system between the detector and the circuitry. Numerical calculations were based on a GM tube which is already available at the institute. Additionally, two systems for position identification are described. (auth)

8210 (JAERI-M-4964) JAERI-TYPE RADIATION MONITORING INSTRUMENTS. Kinbara, S.; Kimura, K.; Tsuchiya, T.; Kumahara, T.; Inomata, S. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 205p. (In Japanese). NTIS (U. S. Sales Only).

The radiation monitoring instruments have been designed and constructed in accordance with the Standard of Radiation Monitoring Instruments. Radiation monitoring systems and alarm systems, using the monitoring instruments, are described, also their specifications, circuit diagram, performance and checking procedures for purposes of maintenance. The instruments include four kinds of G-M probes, three kinds of preamplifiers, an ion-chamber probe, a logarithmic count-rate meter, a direct current amplifier, two kinds of high-voltage power supplies, two kinds of alarm units, a sampler-controller, and a bin power supply. (auth)

8211 (KFK-1638, pp 105-110) MONITOR FOR THE MEASUREMENT OF α-ACTIVITY IN AIR. Haider, B.; Jacobi, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

A measuring device is described which has been developed for the urgently necessary long-time surveillance of the concentration of short-lived ^{222}Rn decay products in the air of some mines. A Si detector records the α-radiation of the radioactive dust components which are deposited on a filter by means of a pump. The device is portable and works about 1 to 2 weeks with single accumulator charge. It can be applied to measure the natural air activity near the ground, as well as the highest activity values to be expected in mines. (GE)

8212 (KFK-1638, pp 231-236) CALIBRATION METHODS AND MEASURING LIMITS OF MONITORS FOR THE SELECTIVE MONITORING OF TRITIUM AND RARE-GAS ACTIVITIES IN AIR. Dobiasch, W. (Muenchener Apparatebau fuer Elektronische Geraete, Munich). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

A combination of a flow and proportional counter and electronic devices are described which can be used for the selective measurement of T and rare gases in a mixing ratio greater than 1:100. It has been tested in nuclear reactors. Besides this high separative power, a detection sensitivity of 2×10^{-9} μCi/ml per ipm for T, and 1×10^{-9} μCi/ml per ipm for rare gases was obtained. For the calibration and compensation of such a device, a relatively exact and practice-oriented measuring procedure is outlined. (GE)

8213 (LBL-2027) TESTING THE PERFORMANCE OF SCINTILLATION CAMERAS. Anger, H. O. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 15p. Dep. NTIS $4.00.

A method is described for testing the inherent resolution of scintillation cameras as a function of count rate. It involves the use of a new test pattern with hexagonal arrays of holes and a "point" source of technetium-99m at a distance covered by a series of lead absorbers to change the effective source strength through a series of values. The new test pattern is believed to be superior to the bar patterns now in use. The sensitivity of the image detector can be determined as a function of count rate at the same time. A simple method is also described that demonstrates whether the setting of the pulse-height selector is critical with regard to the field uniformity obtained. The test procedure is described, and it is shown that by its use significant differences in the performance of scintillation cameras can be demonstrated. (auth)

8214 (N-73-13688) EFFECT OF FILTERING ON NOISE AND TIMING IN NUCLEAR PARTICLE DETECTION. Gary, S. A. (Johns Hopkins Univ., Silver Spring, MD. Applied Physics Lab.). Oct 1970. Contract N00017-62-C-0604. 72p. (NASA-CR-129613; AD-730487; APL-TG-1136). NTIS.

The relations between signal shaping, noise, and timing resolution in nuclear particle detection systems are examined. Mathematical analysis of five commonly used types of filters leads to numerical results for system noise components arising from sources in the preamplifier, detector, and bias resistors. These results are presented in the form of design curves for the various filters, showing the dependence of each output noise component on both the magnitude of the noise sources and the filter time constants. Three of the filters considered are simple RC types; the remaining two are combinations of delay lines and RC elements. The quantitative calculations specifically assume a silicon detector and a field-effect-transistor preamplifier. Those filters that exhibit bipolar step response are analyzed in terms of crossover timing resolution, based on the earlier noise calculations. Again, the results are summarized in sets of design curves for each filter. Finally, the comparative performance of the various filter types is discussed, and specific examples are given. (auth)

8215 (ORNL-TM-4064) DESCRIPTION OF FACILITY RADIATION ALARM SYSTEM IN SPECIAL MATERIALS MACHINE SHOP, ROLLING MILL, AND SOURCE MATERIALS VAULT AT ORNL. Williams, P. P. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 22p. Dep. NTIS $3.25.

A Facility Radiation Alarm System was installed in the Special Materials Machine Shop (Building 3044), Rolling Mill (Building 3012), and Source and Special Materials Vault (Building 3027). Instruments continuously monitor both gamma and neutron radiations (burst and dose) in the first two buildings but only neutron radiation in the vault. The instruments and associated system

components provide health physics information, sound local alarms when abnormal conditions occur, and indicate the abnormal condition on a central panel in Building 3044 and the Laboratory Emergency Control Center (Building 2500). The monitoring instruments also actuate building evacuation alarms in the machine shop and rolling mill when specific levels of radiation are reached. (auth)

8216 (RD/B/M-2489) B. N. L. REACTOR PHYSICS COUNTING LABORATORY. Beynon, A. J.; Smallwood, F. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Nov 1972. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

A counting laboratory has been set up to cover the requirements of the BNL basic reactor physics experimental programme. Scintillation and semiconductor detectors mounted in automatic sample changers are used for γ activation analysis, and boron trifluoride and fission chambers for spontaneous reactor flux measurements. All systems use electronics in a temperature controlled environment to maintain stable operation, and share a single software operated data handling and control facility. The siting and equipping of the laboratory is described. The reasoning behind each of the major design features is explained and the methods used to ensure uniformly good performance from the counting systems are outlined. (UK)

8217 ^{166m}Ho AS AN EFFICIENCY CALIBRATION STANDARD FOR Ge(Li) DETECTORS. Lavi, N. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 109: No. 2, 265-267(1973).

The energies and relative intensities of the gamma rays emitted in the decay of the long-lived isomer ^{166m}Ho (1.2×10^3 y) were measured. This nucleus is recommended for use as a calibration standard for Ge(Li) detectors. (auth)

8218 PROCESS FOR DETECTING RADIOACTIVE SUBSTANCES. Sebening, H. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,598,499. 15 Oct 1970. Filed date 22 Jun 1966. (In German).

A process is described for detecting radioactive substances, especially fission gases in water vapor. The water vapor is cooled, compressed, and condensed at a predetermined pressure, and the noncondensed radioactive substances are then passed through a detector. The process is characterized by the fact that the condensate formed is maintained approximately at the boiling point. (TSS)

8219 DEVICE AND METHOD FOR IMPROVING THE VERTICAL RESOLUTION OF A TWO-DIMENSIONAL TELEVISION-BASED RADIATION DETECTION SYSTEM. Davidson, J. B.; Case, A. L. (to United States Atomic Energy Commission). U. S. Patent 3,729,585. 24 Apr 1973. Filed date 26 Aug 1971. 10p.

A device and method have been provided for improving the vertical resolution in a television-based radiation detection system. Impinging radiation detected in the form of scintillations occurring in a crystal is recorded by a television camera tube. As the information-containing target of the camera tube is scanned, each preceding horizontal scan is delayed one horizontal scan time and compared with the instant scan for coincidence of image, and if there, taking the ratio of the images, followed by testing of the resultant amplitude for proper location in a memory device. The vertical resolution is enhanced beyond that implied by the number of horizontal scans. (Official Gazette)

8220 SCATTERING EFFECTS IN RADIOISOTOPE IMAGING. Dresser, M. M. Ann Arbor, MI; Univ. of Michigan (1972). 158p. University Microfilms Order No. 73-6821.

Thesis (Ph. D.).

The effects of scattered gamma rays on radionuclide images have been investigated using Monte Carlo procedures. The clinical situation has been reduced to the more tractable problem of a point, monoenergetic, isotropic source located at a specified depth below the surface of a semi-infinite water medium. A detector was simulated at the surface of the medium which records either the position and energy of all emergent gamma rays, or utilizing a unique biasing scheme, only those which emerge perpendicular to the surface thus simulating a perfectly absorbing parallel hole collimator. The influence of pulse height selection has been investigated by further restricting the acceptance of gamma rays based upon their escape energy. Data have been generated for escape probabilities, scatter fractions, line spread functions, and emergent energy spectra for sources of 140, 364, and 511 keV, and source depths of 0, 5, and 10 cm. Two of the calculations have been tested experimentally resulting in a general confirmation of the calculated results with understandable experimental deviations. (Diss. Abstr. Int., B)

8221 ELECTROMAGNETIC DISTURBANCE NEUTRALIZATION RADIATION DETECTOR. Gripentog, W. G. (to United States Atomic Energy Commission). U. S. Patent 3,725,661. 3 Apr 1973. Filed date 1 Sep 1971. 8p.

A radiation detector of the Neher-White type is described which automatically neutralizes induced negative charges on the electrometer tube control grid which shuts off the electrometer tube. The detector includes means for establishing a voltage of one polarity in response to plate current and voltage of opposite polarity in response to an absence of plate current and means for connecting the control grid to a reference potential for draining the negative charge in response to the voltage of opposite polarity. (Official Gazette)

8222 RESPONSE OF BISMUTH LOADED LIQUID SCINTILLATORS TO GAMMA RADIATION. Kincaid, C. V. College Park, MD; Univ. of Maryland (1972). 174p. University Microfilms Order No. 73-11,396.

Thesis (Ph. D.).

A coordinated investigation of the effect of gamma radiation on bismuth loaded liquid scintillators was undertaken. A theoretical, computer aided calculation of absorbed energy and scintillator response was performed using the National Bureau of Standards ETRAN 18B. These theoretical results were compared with experimental measurements of a p-dioxane based liquid scintillator and a toluene based liquid scintillator loaded with 0.08 to 3.87% bismuth, by weight, and subjected to ^{137}Cs radiation. The experimental and theoretical results were compared for a 100 cc sample and were in good agreement. The gamma radiation spectrum was extrapolated, theoretically, to both a 10,000 cc and a 1,000,000 cc volume detector. No photopeak was observed experimentally or derived theoretically in these investigations despite an increase in the calculated total absorption and photofraction. (Diss. Abstr. Int., B)

8223 WHOLE-BODY DETECTOR CD-2. Silar, J.; Boucek, J. (Karlova Univ., Prague). Radioisotopy; 13: No. 6, 1213-1307 (1972). (In Czech).

The conception and construction of the clinical whole-body detector CD-2 is described. Measurement results of the main physical parameters of large-volume scintillation detectors with 100 × 120 mm NaI(Tl) crystals and with 65 PK 423 photomultipliers are presented. The collimation characteristics of the detection system and the physical parameters of the CD-2 detector with the evaluation set TESLA NZG-312T are given. The detector is assembled from homemade parts and enables clinical whole-body examinations with a satisfactory statistical precision when using activities in the range from tenths to one μCi in the primary radiation energy region from 150 keV to 2 MeV. (auth)

8224 PORTABLE COUNTING RADIOMETER. Isvoreanu, I. Stud. Teh. Fcon., Inst. Geol. (Rom.), Ser. D; No. 9, 175-180(1972). (In Rumanian).

The radiometer was conceived to detect and trace the γ radiation fields of some geological formations of interest. Better quality is obtained than in commercial radiometers, as the reproducibility of the measurements is effectively within the mathematic hope determined by the statistics of radioactive disintegrations. The portable counting radiometer is to be preferred in all applications for obtaining some comparable and correlatable images of the spatial distribution of the field intensity. (MP)

8225 ELECTRONIC EQUIPMENT IN RADIOPROTECTION. Pajares, J. A.; Goni, A. J. (Junta de Energia Nuclear, Madrid). Energ. Nucl. (Madrid); 17: No. 81, 51-60(1973). (In Spanish).

The general characteristics are presented of two monitors for gamma radiation, of a monitor for beta and gamma radiation, and a fourth for x rays, all intended for the exploration and monitoring of radioactive areas. A description of the basic electronic circuits and the procedures for calibration are given. (tr-auth)

8226 RADIATION DETECTOR AND ITS MANUFACTURE. Meuleman, J. (to La Radiotechnique-Compelec). French Patent 2,118,846. 4 Aug 1972. Filed date 22 Dec 1970. 16p. (In French).

A double contact semiconductor detector for ionizing radiations and high energy particles is presented. It consists of a monocrystalline semiconducting device in which a semiconducting layer of a given type conductivity formed at the outer surface is separated from a zone of opposite type conductivity by an intermediate intrinsic layer. Its entrance window is formed in a part of the semiconducting layer which covers the majority of the outer surface of the device. One of the contacts is made in this zone and the other in the semiconducting layer. (FR)

8227 PORTABLE NUCLEAR RADIATION MEASUREMENT DEVICE. Jordan, K.; Kuehnert, H.; Hofmann, J. (to Frieseke

and Hoepfner GmbH). German Patent 1,802,820. 27 May 1970. Filed date 12 Oct 1968. 10p. (In German).

A portable radiation measurement device with a radiation detector, plotting electronics, recording and adjusting elements, and a connector socket for externally connected accessories is described. A hinged cover is on the housing side with the socket. The hinged cover has on its inside a collar-like or cylinder-like seal of elastic plastic material whose exterior diameter in relation to the interior diameter of the socket is larger so that the seal can be introduced through the hinged cover in the manner of a medical bottle stopper. The seal has a flange which is seated freely in a grove of large diameter in the hinged cover. In the face of the hinged cover there is an inlet gate with lateral groves for the introduction of the flange of the seal. The inlet gate is fitted with a lock and key by means of a shutter fixable with respect to the hinged cover. (JSR)

8228 EFFICIENCY OF ANTHRACENE AS A SUSPENDED SCINTILLATOR FOR COUNTING AQUEOUS NICKEL-63 SAMPLES. Law, J. J.; Smith, J. W.; Scott, M. W. (Longwood Coll., Farmville, VA). Experientia; 29: No. 3, 377-378(15 Mar 1973).

The performance of anthracene crystals, used as a suspended scintillator for assaying ^{63}Ni activity in aqueous medium, is described. (TFD)

8229 COAXIAL ANODE FOR BACKGROUND SUPPRESSION IN X-RAY PROPORTIONAL COUNTERS. Bunner, A. N.; Kraushaar, W. L.; McCammon, D.; Vanderhill, M.; Williamson, F. (Department of Physics and Space Science and Engineering Center, University of Wisconsin, Madison, Wisconsin 53706). Rev. Sci. Instrum. 44: No. 4, 418-422 (Apr 1973).

We have devised, constructed, and tested in flight a scheme which permits the ends (near the anode seals) as well as the bottom and sides of an x-ray astronomy proportional counter to be protected by anticoincidence guard counters. A rocket-borne test has shown that the non-x-ray background is reduced by an additional factor of about 30 when the end guard counter feature is added. (auth)

Radiation Dosimeters

8230 (KFK-1638) RADIATION PROTECTION AT THE WORK PLACE, KARLSRUHE, GERMANY, MAY 17–19, 1972. Koelzer, W. (comp.) (Kernforschungszentrum, Karlsruhe (West Germany)). May 1972. 361p. (In German). (CONF-720562-).

Thirty-three papers were presented at the conference. A separate abstract was prepared for each paper. (TFD)

For abstracts of individual papers see: 8150, 8211, 8212, 8231–8234, 8316, 8401–8412, 8490, 8491, 9959–9961, 9973, 9985, 9991, 9992, 10021–10023, and 10035.

8231 (KFK-1638, pp 111-115) MEASUREMENT OF SURFACE DOSE PRODUCT IN X-RAY DIAGNOSIS. Pychlau, P. (Physikalisch-Technische Werkstaetten, Freiburg i. B.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

An ionization chamber was developed to measure the exposure in diagnostic x-ray procedures. The chamber, consisting of 20 × 20 cm parallel plates at a distance of 2 cm, was mounted at the portal of the x-ray machine. The measurement yielded the product of dose and area which was independent of the target-patient distance. To handle both fluoroscopy and x-ray films, special additional attachments were developed. (HBG)

8232 (KFK-1638, pp 147-168) CRITICAL COMPARISON OF FILM AND ROD DOSIMETER MONITORING ON THE BASIS OF STATISTICAL INVESTIGATIONS IN THE JUELICH NUCLEAR RESEARCH CENTER. Rose, E. (Kernforschungsanlage, Juelich, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

For more than ten years, both film and rod dosimeters were used for routine monitoring of external exposure. Data obtained during 1971 were compared statistically. For one individual, addition of either the film or the rod doses yielded essentially comparable values. At doses above 1000 mR, the discrepancy never exceeded 30%. It was concluded that film dosimeters were sufficiently exact for personnel monitoring. (HBG)

8233 (KFK-1638, pp 183-194) FINGER DOSIMETER FOR THE MEASUREMENT OF NEUTRON RADIATION. Burgkhardt, B.; Piesch, E. (Kernforschungszentrum, Karlsruhe, Ger.); Buijs, K.; Vaane, J. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The conditions governing the use of solid nuclear track detectors for ^{252}Cf dosimetry have been simulated in a neutron-shielded facility. The neutron energy spectra of a ^{252}Cf-source have been obtained for various distances from the source; more than 90% of the total neutron dose received during normal work at usual distances from the source are made up of neutron energies of more than 0.75 MeV and the dose is found to be inversely proportional to the square of the distance to the source. Quite an important problem to be solved was the design and realization of a stable holding device for the dosemeter. It has to protect the thin foil and to guarantee simple exchange of foils. The dosemeter itself consists of fission foils (^{237}Np, ^{232}Th) which are in contact with polycarbonate foils. In addition, a thick polycarbonate foil has been inserted into the dosemeter for measuring the neutron-induced recoil reactions. Counting is made automatically by a spark counter. The sensitivity of the dosemeter is 200 mrem. (GE)

8234 (KFK-1638, pp 195-206) NEUTRON DOSIMETRY WITH LiF. Burgkhardt, B.; Piesch, E. (Kernforschungszentrum, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The applicability of LiF–albedo dosemeters in personnel dosimetry for the detection of fast neutrons is discussed. This albedo dosemeter is composed of a TLD-600 and a TLD-700 dosemeter in order to separately detect the neutron dose and gamma dose. The neutrons which are moderated and backscattered in the body of the person carrying the dosemeter are thus detected mainly by the TLD-600 dosemeter, and the neutron contribution can be determined from the difference between the values measured by the TLD-600 and the TLD-700 dosemeter. A series of irradiation experiments with a ^{252}Cf source have shown that such a dosemeter, tested with a phantom in the form of a human body, will indicate neutrons proportional to the dose even in the energy range of fast neutrons. The results of these experiments with phantoms, made with various distances from the source and behind various shieldings, show to what extent the indication of an albedo dosemeter is dependent on the degree of moderation of neutrons and on the position of the body as related to the irradiation source. (GE)

8235 (SLAC-Trans-156) MEASUREMENT AND REPRODUCTION OF THE ROENTGEN EXPOSURE UNIT AT THE GERMAN MEASUREMENT AND TESTING AGENCY. Part II. Cavity Ionization Chambers for ^{60}Co and ^{137}Cs Gamma Radiation. Hecker, O.; Rothe, H. Translated from Isotopenpraxis; 8: No. 10, 373-379(1972). 22p. Dep. NTIS $3.25.

A description of the normal DAMW measuring devices (free-air ionization chambers) for the measurement of the exposure unit for the energy range of X-ray radiation was previously given, and the corresponding devices for the γ radiation of ^{60}Co and ^{137}Cs are treated. The basis for the determination of the unit according to definition consists of various cavity ionization chambers of highest-purity graphite, the construction of which is described. They are of the cylindrical type and have measuring volumes of about 2, 8, 30, and 100 cm^3. The charge-measuring device is again an electrometric photocell compensator. The determination of the correction factors necessary in the collimated bundles of rays is treated in detail. The maximum error in the determination of the unit of exposure is 2%. (auth)

8236 (STI/PUB-338) NATIONAL AND INTERNATIONAL RADIATION DOSE INTERCOMPARISONS. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, 13-17 December 1971. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. 170p. (In English and Russian). (CONF-711225–). IAEA $6.00.

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971).

A separate abstract was prepared for each of the 20 papers presented. (WDK)

For abstracts of individual papers see: 8237–8255, and 9895.

8237 SOME COMPARISONS ORGANIZED BY THE INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES. Allisy, A. (International Bureau of Weights and Measures, Sevres, France). pp 1-5 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

The role and organization of the International Bureau of Weights and Measures is described in general, with particular reference to

dose measurements of ionizing radiation. Examples are given of international dose comparisons organized by the BIPM, and some of the methods and results are discussed for ^{60}Co gamma rays and x-rays. (auth)

8238 MEANS TO ACHIEVE DOSE INTERCOMPARISONS. Behounek, F. (Lab. of Radiological Dosimetry, Prague). pp 7-10 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

This report is based on experiments at the Laboratory of Radiobiological Dosimetry in Prague and deals with the means to achieve dose intercomparisons. The experiments refer to x-rays up to 220 kV, ^{60}Co gamma rays, and 20-MeV photons from a betatron. Some measuring systems such as calorimetry, free-air pressure ionization chambers, and chemical dosimeter systems as well as TLD are briefly referred to. (auth)

8239 ACHIEVEMENT OF UNIFORMITY OF MEDICAL DOSIMETRY IN THE NORDIC COUNTRIES AND ITS RELATION TO ABSORBED DOSE INTERCOMPARISONS. Bengtsson, L. G. (National Inst. of Radiation Protection, Stockholm). pp 11-16 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

Much work has been devoted to increasing the uniformity of dosimetry in the Nordic countries. Starting with standardization and international intercomparisons of standards, extensive intercomparisons of absorbed dose determination at Nordic medical accelerators have recently been carried out by a group from Umeå University. Following this, recommendations on measurement procedures have been worked out and agreed upon. Presently an experimental follow-up of the realization of the recommendations is discussed. Future work will primarily be concerned with extension to dosimetry in the patient rather than with further elaboration of the absorbed dose determination in a water phantom. The Nordic experiences on ionization chamber measurements and on the need for specifications relating to the radiation beam are discussed in the light of their possible application to absorbed dose intercomparison programs. (auth)

8240 NATIONAL AND INTERNATIONAL RADIATION DOSE INTERCOMPARISONS IN HUNGARY. Bozoky, L. (National Oncological Inst., Budapest). pp 17-19 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

The activities of the National Oncological Institute in Budapest in the field of radiation dosimetry are reviewed. Particular reference is made to dose intercomparison between the absolute R-measuring equipment and the Küstner dosimeter; intercomparison with the National Office of Measurements; and international intercomparisons. Results and experiences from these activities are briefly discussed. (auth)

8241 COMPARISONS OF X-RAY DOSIMETRY FOR THE COORDINATION OF LATE EFFECTS RESEARCH IN EUROPE. Broerse, J. J. (Radiobiological Inst. TNO, Rijswijk, Netherlands); Puite, K. J. pp 21-31 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

Comparisons of absorbed dose and dose distribution for x rays with effective energies of 80 to 130 KeV were carried out as a part of a cooperative European program on late effects research. A postal dose intercomparison service was organized using LiF thermoluminescent dosimeters. The intercomparison studies demonstrated a number of discrepancies with respect to the absolute dosimetry and the exposure conditions employed at the participating institutions. Only for six out of fourteen institutions did the absorbed dose agree to ±5% relative to the standard value, while for four institutions the absorbed dose differed by about 10% or more from the standard value. With regard to the dose distribution it was concluded that only five out of thirteen institutions are able to perform mice irradiations under conditions of uniform irradiation. The results of the intercomparisons indicate the need for standardization of x-ray dosimetry, to allow comparison of biological results obtained at the participating institutions. (auth)

8242 INTERCOMPARISON OF READOUT SYSTEMS FOR THE CLEAR PERSPEX DOSIMETER. Chadwick, K. H.; ten Broeke, W. R. R.; Rintjema, D. (EURATOM-ITAL, Wageningen, Netherlands). pp 33-40 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

Experiments were performed to intercompare dose readout systems (spectrophotometers) between the Institute for Application of Atomic Science in Agriculture and similar laboratories in the United Kingdom and the United States of America. The HX-dosimetry perspex was used to cover the dose range between 10^5 and 5×10^6 rad. The results of these experiments are reported. (auth)

8243 DOSIMETRY PERFORMANCE TESTS. Ehrlich, M. (National Bureau of Standards, Washington, DC). pp 41-57 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

A discussion of the need for critical studies of radiation measurement techniques and routine measurement performance is presented. The aim of such studies is to improve practical measurement performance by periodic testing and by the distribution of the knowledge gained by the participants in such tests. Besides general considerations, such items as test pattern, choice of dosimeters and examples from tests are discussed. (auth)

8244 RELEVANCE OF ABSORBED DOSE STANDARDIZATION AND INTERNATIONAL DOSE INTERCOMPARISONS WITH RESPECT TO THE USE OF PULSED ELECTRON ACCELERATORS. Holm, N. W. (Atomic Energy Commission Research Establishment Risoe, Roskilde, Denmark). pp 67-77 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

The increasing use of high-energy photon and electron sources in radiation therapy and in radiation processing has prompted international and national standards laboratories to devote much effort to providing absorbed dose standardization services for these sources. It is attempted to draw attention to the serious influence of the extreme dose rates obtained from pulsed electron accelerators on the radiation effect of a given absorbed dose and to suggest alternative means of standardization. (auth)

8245 PERSONAL DOSIMETRY PERFORMANCE TESTS FOR RADIOLOGICAL PROTECTION PURPOSES. Langmead, W. A. (National Radiological Protection Board, Harwell, Eng.). pp 79-91 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

The purposes and practical problems of dose performance tests are discussed for individual monitoring in radiation protection work in the United Kingdom. Examples of such tests are reported. The authors feel that tests for such purposes are usually welcomed by the participants. Apparently most reputable laboratories specializing in this type of work can achieve about two thirds of their routine dose measurement within ±20% of the true dose. (auth)

8246 SURVEY OF REGIONAL CALIBRATION FACILITIES FOR BIOMEDICAL RADIATION DOSIMETRY IN THE UNITED STATES OF AMERICA. Lanzl, L. H. (Univ. of Chicago). pp 93-98 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

Three main points are dealt with in this report: (1) organizational arrangements and implementation of intercomparisons or intercalibrations; (2) types of instruments and techniques employed; (3) intercomparison of exposure and absorbed dose in generalized as well as specific geometries. The discussion is limited to teletherapy radiation beams and experiences gained in United States institutions. (auth)

8247 PROBLEMS RELATING TO DOSIMETRIC SYSTEMS INTERCOMPARISON. Bochkarev, V. V.; Bregadze, Yu. I.; Levochkin, F. K.; Radzievskii, G. B. (State Committee for Utilization of Atomic Energy, Moscow). pp 99-105 of National

and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973). (In Russian).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

The problem of radiation dosimetry is reviewed in two fields, radiotherapy (including radiobiology) and radiation technology. Calibration instruments (primary standards) are described. The accuracy with which absorbed doses are determined does not always meet modern requirements. The time is ripe to create a set of appropriate primary standards (calorimeters). An adiabatic calorimeter is described for measuring absorbed doses of x- and gamma-rays in the dose range from 1 to 10^4 rad/s (the radiotherapy range), and a quasi-adiabatic calorimeter for measuring absorbed doses from beams of accelerated electrons with energies greater than 10 MeV (radiation technology range). A description is also given of two ionization chambers with a variable electrode gap and variable pressure, which are used to determine absorbed doses from low-penetrating radiations. Attention is devoted to reference dosimetric systems (secondary standards), and dosimeters in current use are discussed in detail. (auth)

8248 RADIATION CHEMICAL REACTIONS AS A MEANS OF DOSE COMPARISON. Minder, W. (World Health Organization, Bern). pp 107-116 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

Advantages and disadvantages of certain chemical reactions used for radiation dosimetry are discussed, in particular from the point of view of dose comparison measurements. The chemical reactions and requirements for dose comparisons and the response of the substances to various types of radiations are studied. (auth)

8249 MULTINATIONAL SURVEY OF THE STATUS OF ^{60}Co RADIATION THERAPY DOSIMETRY. Moos, W. S.; Balamutov, V. G.; Abedin-Zadeh, R. (International Atomic Energy Agency, Vienna). pp 117-125 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

A survey based on a joint IAEA/WHO project is given on the present status of dosimetry in various parts of the world. The study is limited to results obtained from ^{60}Co teletherapy units. Such results indicate that over 40% of the participating institutions deviate by more than ±5% from the reference values. (auth)

8250 INTERCOMPARISON BETWEEN CALIBRATION LABORATORIES OF ABSORBED DOSE DETERMINATION FOR HIGH-ENERGY ELECTRONS. Pohlit, W. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main). pp 127-136 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

The internal check of different types of standard instruments for high-energy electrons in one institution is described. It shows that suitable accuracy can be achieved for the intended purposes. Also described are different methods of intercomparison between similar institutions using a standard instrument. The results indicate that it is possible for such institutions, using different methods, to determine absorbed dose with an accuracy of 2%. (auth)

8251 JOINT IAEA/WHO TLD INTERCOMPARISON PROGRAM: EVALUATION OF THE PRESENT SITUATION. Classen, I.; Seelentag, W.; Waldeskog, B. (World Health Organization, Geneva). pp 137-140 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

Methods of evaluation and results obtained from the joint IAEA/WHO TLD postal dose comparison tests are presented. The results indicate that in many areas of the world dosimetry has to be improved. Explanations for some of the bad results cannot be given at present, although lack of adequate training seems to play an important role. (auth)

8252 ACTIVITIES IN THE FIELD OF RADIATION DOSIMETRY, CALIBRATIONS, AND INTERCOMPARISONS AT BARC, TROMBAY. Sunta, C. M.; Gupta, U. C.; Shahani, M. G. (Bhabha Atomic Research Centre, Bombay). pp 141-146 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

The calibration facilities at BARC, Trombay, include a standard ionization chamber and a panoramic exposure assembly for gamma-ray exposure, a graphite pile for standard thermal neutron flux density and a manganese sulfate bath facility for neutron source standardization. Some results of international intercomparisons are presented. Experience with natural CaF_2 thermoluminescent dosimeters is briefly described and it is suggested that thermoluminescent dosimetry presents a suitable system for intercomparison studies. (auth)

8253 REPORT AND RECOMMENDATIONS OF THE INDUSTRIAL IRRADIATION TASK GROUP. pp 147-149 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

It is recommended that dose intercomparison services be set up to (1) obtain comparable research data pertinent to the initiation of any irradiation process on an industrial scale (±3% accuracy), and (2) provide suitable absorbed dose information for the commissioning and operation of industrial irradiation plants (±10% accuracy). It is recommended that these services be provided through the IAEA dosimetry facilities or by any appropriate laboratory designated and approved by IAEA and/or WHO. (WHK)

8254 REPORT AND RECOMMENDATIONS OF THE MEDICAL TASK GROUP. pp 151-153 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

There is an immediate need for comparisons to determine the correct assessment of absorbed dose in the fields of radiation therapy and radiation biology (including studies of late effects) for the following types of radiation: Orthovoltage x radiation (100 to 300 kV), ^{60}Co gamma rays, and high-energy bremsstrahlung and electrons (1 to 50 MeV). In the future, the IAEA in cooperation with WHO may extend their medical comparison service to other types of radiations, notably: short distance x-ray therapy (below 100 kV), fast neutrons, and negative pions, with continued consideration given to the work of other international organizations such as the ICRU. (ERB)

8255 REPORT AND RECOMMENDATIONS OF THE WORKING GROUP ON PERSONAL DOSIMETRY PERFORMANCE TESTS FOR RADIATION PROTECTION PURPOSES. pp 155-159 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

National and international dose performance tests made in the field of individual monitoring used in radiation protection work are considered. The present status of such experiments is discussed and the need for further performance tests involving personal monitoring laboratories in those Member States not having direct access to a national or regional Secondary Standards laboratory is considered. The Working Group makes proposals for determining by means of a questionnaire States that might wish to take part in international performance test experiments and discusses in general terms the relative contributions that the IAEA, in conjunction with the WHO, could make in association with a designated laboratory at which dosimeter irradiations would be made. Proposals are presented for a regime of performance test experiments based on the assumption that the replies to the questionnaire demonstrate that a need for such experiments exists. (auth)

8256 DOSIMETRIC PROPERTIES OF NEUTRON BEAMS PRODUCED BY 16 TO 60 MeV DEUTERONS ON BERYLLIUM. Almond, P. R.; Smathers, J. B.; Oliver, G. D. Jr.; Hranitzky, E. B.; Routt, K. (Univ. of Texas, Houston). Radiat. Res.; 54: No. 1, 24-34(Apr 1973).

Beams of fast neutrons were produced by a variable-energy cyclotron, using the ^{9}Be(d,n)^{10}B reaction. The Be target thickness was 12.1 mm; Benelex material was used for collimating the neutron beams. A field of 5 × 5 cm at 125-cm target-surface distance was used for most measurements; the phantom employed was a Lucite-walled tank filled with tissue-equivalent (T-E) liquid. The absorbed dose rate in terms of rad/min/μA was measured at deuteron (d) energies between 16 and 60 MeV and found to follow an

$E^{2.67}$ relationship; the results are in agreement with previous data at the lower energies. Central axis depth-dose data were measured using d energies of 16, 30, and 50 MeV; the depth of the ½ maximum dose was found to increase with energy from 8.5 cm at 16 MeV to 12.0 cm at 50 MeV. Positions of maximum dose buildup were measured with an extrapolation chamber; at the higher energies these maxima were found to occur at depths greater than from ^{60}Co γ-rays. The effectiveness of the collimator was measured for 16, 30, and 50 MeV d. Data obtained in the phantom indicated that outside the defined beam the dose was 5% of the maximum, independent of energy. Measurements outside the phantom indicated that 40% of that was attributable to transmission through the collimator. An estimate of the n/γ ratio was made using a paired ion chamber system (T-E and carbon); while calculations were done for 16 MeV, more data on the response of the carbon chamber to the higher energy neutrons are needed to obtain the ratio at 50 MeV. At 16 MeV the entrance gamma dose is 5% of the neutron dose and at 10 cm it is 14%. Preliminary indications are that these numbers do not increase much at higher energies. (auth)

8257 USE OF A VAN DE GRAAFF GENERATOR AND A PRESSURE DEFINED FOR THE ABSOLUTE REPRESENTATION OF THE R-UNIT FOR HIGH-ENERGY QUANTUM RADIATION. I. Reconstruction and Testing of the Van de Graaff Generator as an X-Ray Generator. Kunze, R.; Rothe, H.; Schulz, G. (Martin-Luther Univ., Halle, Ger.). Isotopenpraxis; 8: No. 11-12, 423-430(1972). (In German).

New measuring equipment has been supplied by the DAMW for the representation and propagation of the R-unit in the range of high-energy quantum radiation. Their principal constituents are a combined pressure-defined magnetic-field ionization chamber as primary standard and a Van de Graaff generator as an x-ray generator with excitation potential ranging from 0.6 to 1.8 MV. The reconstruction and testing of the Van de Graaff generator supplied by the manufacturer as an electron accelerator are discussed, and the results of dosimetry performed in the generator cell and of the generator yield measurement are presented. (auth)

8258 USE OF A VAN DE GRAAFF GENERATOR AND A PRESSURE DEFINED MAGNETIC-FIELD IONIZATION CHAMBER FOR THE ABSOLUTE REPRESENTATION OF THE R-UNIT FOR HIGH-ENERGY QUANTUM RADIATION. Part II. Design and Testing of the Combined Pressure-Defined Magnetic-Field Ionization Chamber. Kunze, R.; Rothe, H.; Schulz, G. (Deusches Amt fuer Messwesen und Warenpruefung, Berlin). Isotopenpraxis; 8: No. 11-12, 431-440(1972). (In German).

The design and the testing of a pressure-defined magnetic-field ionization chamber for providing the representation of the exposure unit for x-bremsstrahlung energy values ranging between 0.6 and 1.8 MeV with a measuring accuracy being 2 percent are discussed. The standard chamber has been designed to perform measurement with air pressures up to 20 kg/cm^2. The magnetic field to reduce its cross-dimensions is produced by an end-correction cylindrical coil, which encloses in itself the cylindrical pressure case made of non-ferromagnetic steel. The ionization chamber is of the cylindrical-shell type. The investigation performed to determine the working characteristics of the chamber is described, and the correction factors entering the equation for determination of the exposure are related briefly. (auth)

8259 CYLINDRICAL PERSONNEL DOSIMETER WITH IDENTIFICATION MEANS. Friedrich, K.; Rudloff, A. H.; Hardt, H. J.; Buttler, W. (to Total Foerstner and Co.). German Patent 1,639,579. 29 Apr 1971. Filed date 26 Sep 1964. 6p. (In German).

A cylindrical personnel dosimeter with identification means is described. A cylindrical chamber fixed for the taking of an identification means first serving for the identification of the person is sealed with a tight lid and is arranged together with a cylindrical radiation detector within a cylindrical casing rigidly connected to the detector. A second identification means is placed on the outside. The complete cylindrical casing is covered. (JSR)

8260 POLY(HALO)STYRENE THIN-FILM DOSIMETERS FOR HIGH DOSES. Bishop, William P. (Sandia Laboratories, Albuquerque, New Mexico 87115); Humpherys, Kent C.; Randtke, Peter T. Rev. Sci. Instrum. 44: No. 4, 443-452 (Apr 1973).

A useful thin-film passive dosimeter system has been developed through use of a poly(halo)styrene matrix doped with malachite green methoxide as an indicator. Extensive characterization studies of the chlorostyrene dosimeters have been completed and the range of conditions under which they are useful has been defined. Exposure to radiation causes development of a blue color (absorption at 630 and 430 nm) which has an optical density proportional to dose over the range 10^4–10^7 rad and may be calibrated to above 3×10^7 rad. No effects of dose rate have been observed between 10^2 and 10^{15} rad/sec, and no effects of photon energy between 2 keV x-rays and 1 MeV gamma rays. Of the environmental parameters studied, only extraneous uv light, temperature, and a few noxious gases have a significant effect on the performance of the dosimeters. Oxygen has only a small effect (a few percent) at low dose rates, but acidic gases such as NO_2, SO_2, and HCl will first color, then bleach the films. The rate and ultimate amount of coloration are dependent on temperature, but this effect is negligible from 0 to 35°C. These films have an indefinite shelf life at room temperature in the absence of light and corrosive gases, and the small effects of oxygen and temperature can be compensated for in the calibration for a particular application. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 7881, 9607, and 9664.

8261 (BUP-40) SOLID STATE CHARGED PARTICLE SPECTROMETER IN THE ROCKET PROTON I. Lindalen, H. R.; Soeraas, F.; Njaastad, S.; Ryngoeye, T. (Bergen Univ. (Norway). Dept. of Physics). Apr 1972. 23p. INIS.

The experiment was designed for use in rockets with a pulse code modulated (PCM) telemetry system. It will measure the differential energy spectrum and pitch angle distribution of electrons and protons above 20 keV with high resolution. It is part of the payload in the two Nike–Tomahawk rockets, Proton I and II, which have been built to investigate various aspects of the particle precipitation at high latitudes with emphasis on the proton precipitation. Proton I was launched on February 13th 1972 and while it is too early to present scientific results, it is apparent that the equipment has functioned as expected. (INIS)

8262 (JAERI-M-5000) Si(Li) DETECTORS AND THEIR APPLICATIONS IN NUCLEAR SPECTROSCOPY. Ishii, M. (Japan Atomic Energy Research Inst., Tokyo). Oct 1972. 81p. (In Japanese). NTIS (U. S. Sales Only).

Background information for workers who will use Si(Li) detectors in their experiments is presented. An outline of the interaction of radiations with matter and a brief description of the properties of semiconductor crystals and detectors are given. A simple technique of fabricating Si(Li) detectors is described and the problems associated with obtaining good energy resolution in detector systems are considered. Also, applications of Si(Li) detectors in nuclear spectroscopy are discussed, and a new method for detection of internal conversion electrons following beta decay is reported. (auth)

8263 (JAERI-M-5067) INTEGRAL TYPE FITTING ANALYSIS OF GAMMA-RAY SPECTRA FROM SEMICONDUCTOR DETECTORS. Taska, K. (Japan Atomic Energy Research Inst., Tokyo). Dec 1972. 36p. (In Japanese). NTIS (U. S. Sales Only).

Gamma-ray spectra from semiconductor detectors are generally analyzed by the least squares technique to determine accurately the center, area and half value (FWHM) of each photopeak in the spectra. The present method calculates the peak component of each channel by the integration of the shape function over the channel width. The shape function is made from the observed spectrum of monoenergetic gamma-rays through the subtraction of background gamma-rays and smoothing of the data. The method was examined for the simulated gamma-ray spectra of Gaussian peaks and observed ones and compared with the results by the ordinary method which gives the peak component of each channel as the value of the shape function at the center of each channel. The present method is able to predict the center, area and half value of each photopeak in the spectrum accurately even when the channel width is so large that the peak shape is expressed by a few data points. The dependence of the fitted results on the channel width is lessened, and it may be considered that the degrees of freedom is increased in the selection of the channel width for measuring the gamma-ray spectrum, supposing one analyzes it by the integral type fitting. (auth)

8264 (LFEN-NI-74) TIME OF FLIGHT UNIT FOR SLOW NEUTRON SPECTROSCOPY. Barros, A. M. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 56p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $5.00.

The design and construction of a time-of-flight unit designed to function in association with previously existing apparatus are described. The design criteria are briefly outlined. The operational principle of the time-of-flight unit is given. The control system, the printout and transmission systems, and the multiplexer are described in some detail. (JSR)

8265 (LYCEN-7282) RESOLUTION OF THE ELECTRONICS OF AN X-RAY SPECTROMETER UNIT HAVING SEMICONDUCTOR DETECTORS. Stroback, H. (Lyon Univ. (France). Institut de Physique Nucleaire). 15 Dec 1972. 23p. (In French). Dep. NTIS (U.S. Sales Only) $3.25.

The various noise parameters affecting the electronic resolution of an x-ray spectrometer unit are examined. Different types of charge preamplifier, which enable certain of these parameters to be minimized, are described. The currently achievable limiting resolutions are given. (FR)

8266 (RD/B/N-2572) NSDA: A FORTRAN IV PROGRAM FOR UNFOLDING CONTINUOUS PULSE HEIGHT DISTRIBUTIONS. Davies, B. S. J.; Fraser, A. J.; Johnson, D. M.; Woollam, P. B. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb 1973. 22p. (RPC/Sh/P-(73)5). Dep. NTIS (U. S. Sales Only) $3.25.

The NSDA (Non Singular Detector Analysis) is used for unfolding pulse height distributions into flux spectra, mainly γ fluxes for shielding applications. The basic formalism of the method is presented together with details of the different versions. Examples are given of the results obtained using two sizes of NaI scintillators. (UK)

8267 THERMOLUMINESCENCE DOSIMETER SYSTEM. Culley, J. C. (to United States Atomic Energy Commission). U. S. Patent 3,725,659. 3 Apr 1973. Filed date 16 Mar 1971. 8p.

A system for obtaining radiation spectrum information utilizing a single thermoluminescent (TL) dosimeter is described. After subjecting the single TL dosimeter to radiation in a manner so that a plurality of areas of the dosimeter experience radiation exposures which differ from each other, such as by overlaying the dosimeter with one or more radiation filters, at least a portion of the individual areas of differing radiation exposure are individually heated to thermoluminescence while the emitted light is observed. The information on the light emitted from the individual areas is then utilized to unfold the characteristics of the radiation to which the dosimeter was exposed. (Official Gazette)

8268 CHARACTERISTICS OF Si(Li) DETECTORS OF NUCLEAR RADIATION. Azimov, S. A.; Aidinova, D. M.; Muminov, R. A.; Yafasov, A. Ya. (Physical-Technical Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 59-62 (1973). (In Russian).

Si(Li) detectors were prepared from single crystals of p-silicon with a thickness of the working area of 2 to 6 mm, an area of 1.25 to 2.5 cm^2, and a minimum dead layer of $\approx$120 Å. These were used as diffusion-drift spectrometric detectors based on a p-i-n structure. Volt-ampere and volt-capacitance characteristic curves and the temperature dependence of the reverse current were measured. The influence of dislocations in the materials was studied, and the optimum conditions for operation were ascertained. (KSW)

8269 PROFILE OF NUCLEAR SPECTROSCOPIC STUDIES OF RADIOACTIVE NUCLEI AS SEEN FROM INSTRUMENTATION. Hayashi, T. (Kyoto Univ., Kumatori, Japan). Nippon Genshiryoku Gakkaishi; 14: No. 11, 600-608(Nov 1972). (In Japanese).

The present status of nuclear spectroscopy with the use of radioactive nuclides as seen from the side of instrumentation and experimental methods is reviewed. It is remarked that the current status of progress in nuclear instrumentation is mainly due to improvements seen in the precision and rapidity of measurements. The impact brought upon γ-ray spectroscopy by the introduction of Ge detectors with their marked precision is described in connection with the resulting revelation of the complexity of the nuclear decay scheme. Mention is made of the tendency toward the use of multichannel detection equipment to increase the rapidity of measurements, an example being the multicounter goniometer in angular correlation measurements. The necessity of an on-line irradiation facility or an isotope separator on-line system (ISOL system) is emphasized for the studies of short lived nuclei. Plans for the future are presented. (auth)

8270 PORTABLE SPECTROMETER FOR X-RAY FLUORESCENT ANALYSIS. Novakova, O.; Slezak, V. (Vyzkumny Ustav Pristroju Jaderne Techniky, Premysleni, Czech.). Radioisotopy; 13: No. 6, 1151-1167(1972). (In Czech).

The requirements put upon the electronic part of the equipment are discussed in the light of two evaluating methods: the method of Rossi filters and the method of pulse height selection. Scintillation detectors and proportional counters are considered. Some characteristics of the prototype portable spectrometer are stated. (auth)

8271 INSTRUMENTAL METHODS OF ELECTRON SPECTROMETRY AND METHODS OF ELECTRON DETECTION. pp 3-50 of Low Energy Electron Spectrometry. Sevier, K. D. New York; John Wiley and Sons, Inc. (1972).

Topics reviewed include magnetic spectrometers, electrostatic analyzers, magnetic field annulment, electron energy analysis in electron microscopy, and electron detection devices. (304 references) (WHK)

8272 PERFORMANCE OF A COUNTING HEAD FOR AUTOMATIC SAMPLE CHANGER. Bibby, D. M.; Rasmussen, S. E. (Univ. of the Witwatersrand, Johannesburg). Radiochem. Radioanal. Lett.; 14: No. 1, 9-15(25 May 1973).

The performance of a counting head designed to be used in conjunction with an automatic transfer system at close distances to a Ge/Li/ detector for neutron activation analysis has been assessed. Two main sources of error inherent in an earlier model have been eliminated. (auth)

High Energy Physics Instrumentation

8273 (FRNC-TH-324) USE OF GEOMETRICAL RELATIONS FOR HPD MEASUREMENTS OF BUBBLE CHAMBER PHOTOGRAPHS. Leguey, A. (Paris Univ. (France)). [nd]. 70p. (In French). NTIS (U. S. Sales Only).

Thesis.

An attempt was made to reduce the processing involved when using HPD systems (Hough Powell devices) by diminishing the constraints imposed by the premeasurement techniques. Correlations existing between different views of the same event were utilized. New filtering techniques were developed to simplify the premeasurement operation which remains classical for the first view (determination of the position of the apex and two points for each track). The apex + 1 point per track information was considered for the second view and nothing for the third view. The rate of rejection obtained for $\bar{p}p$ events at 3 to 6 GeV/c was identical to that obtained with the classical method (7%). Another procedure using only the position of the apex in the second view was then used. When the same $\bar{p}p$ events were considered, the rejection rate remained constant, but the filtering time rose by 20%. The (apex + point) mode is currently being used in a K^+d experiment at 8.25 GeV/c. Preliminary results demonstrate that 90% of the events are accepted at the input of the geometry program. The filtering time is less than 3 seconds of CDC 6600 for three pronged, three pronged + V^0, four pronged, and four pronged + V^0 events. The results appear to be in agreement with the preliminary $\bar{p}p$ tests. (FR)

8274 (JINR-E1-6976) CHERENKOV TOTAL ABSORPTION SHOWER COUNTER. Adylov, G.; Aliev, F.; Gajewski, W.; Ion, I.; Kulakov, B.; Popielski, W.; Tsyganov, E.; Vodopianov, A.; Dally, E.; Drickey, D.; Liberman, A.; Shepard, P.; Tompkins, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

A Cherenkov total absorption counter is described which was used for scattered electron detection in the experiment on π^-e scattering at 50 GeV. (auth)

8275 (JINR-P13-7076) SIMPLE METHOD (DOUBLE REFLECTION METHOD) OF MEASURING THE AVERAGE PROTON ENERGY ON VAVILOV–CHERENKOV RADIATION. Zrelov, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A simple method is described for measuring the average energy of relativistic particles based on Vavilov–Cherenkov radiation appearing in the trigonal prism-radiator with mirror surfaces. The calculation formulas are presented. The accuracy of the proton energy measurement achieved by this method is estimated. (auth)

8276 (LBL-1503) STIMULATED EMISSION IN NEON–HELIUM STREAMER CHAMBERS. Stetz, A. W. (California Univ., Livermore. Lawrence Livermore Lab.). Nov 1972. Contract W-7405-eng-48. 44p. Dep. NTIS $4.00.

The possibility of using stimulated emission in the gas of a streamer chamber to improve the quality of the image that is photographed was investigated. The incremental gain from stimulated emission obtainable in a practical streamer chamber has been estimated from some related experiments with pulsed lasers. A model of the dynamics of laser beam formation in a streamer chamber was constructed, and the light available for photography estimated. Despite the uncertainties in these estimates, the calculations definitely suggest that a system in which the chamber is "primed" by an external light source would produce substantial gain in output light intensity compared with the conventional streamer chamber. Several suggestions for further research in streamer chamber improvements based on laser technology are given. (auth)

8277 (N-72-29469) MULTIWIRE PROPORTIONAL COUNTER DEVELOPMENT. Quarterly Progress Report. (TRW Systems, Redondo Beach, Calif.). 31 Jan 1972. Contract NAS9-11315. 14p. (NASA-CR-115732). NTIS.

A test run was made at the Bevatron to check the character of signals induced in an electromagnetic delay line capacitively coupled to the wire cathode plane of a multiwire proportional chamber. In particular, these signals and the behavior of the readout electronics as a function of associated delta-ray production are studied. These measurements are important in assessing the effect of delta-ray background on the spatial resolution attainable for the primary ions. Test results are used to design a multiwire proportional chamber and readout system for use as spatial detectors in a superconducting magnetic spectrometer experiment. (auth)

8278 (UCRL-51369) METHOD OF EVALUATING SCANNING EFFICIENCY FOR QUARK-LIKE (PSEUDO) TRACKS IN A FLAT GEOMETRY CLOUD CHAMBER. Ernst, R. D. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Mar 1973. Contract W-7405-eng-48. 11p. Dep. NTIS $4.00.

Further uses of artificially produced cloud-chamber tracks used in the quark quest are discussed. These tracks were used to train scanners to look for $1/9$ normal-density tracks, and to measure a scanner's efficiencies for finding $1/9$ and lower ($1/12$, $1/18$, and $1/36$) normal-density tracks. (auth)

Radiometric Instruments

8279 (COO-3206-14) DEVELOPMENT OF AN INDWELLING INTRACRANIAL PRESSURE SENSOR. Phase I. Lyon, W. C. (Hittman Associates, Inc., Columbia, MD.). Jun 1972. Contract AT(11-1)-3206. 41p. Dep. NTIS $4.00.

Results of Phase I of a three-phase program to develop a fully implantable, long-term intracranial pressure sensor that employs a radioisotope as part of the pressure readout system are reported. The major accomplishment of the Phase I effort was the implantation and short-term testing of two devices in a canine to establish proof of principle and determine overall characteristics. Additional accomplishments were the design, fabrication, and evaluation of suitable devices; and the establishment of experimental characteristics via a number of laboratory tests prior to implantation. A straightforward design that is installed beneath the skin, with no penetrations to the ambient, has been accomplished. Subdural pressure is sensed via a tambour, and is transmitted to the remainder of the device via a small tube that penetrates the skull. External sensing is accomplished via a survey meter equipped with a detector suitable for counting low energy photons. The subdural pressure is directly correlatable to the count rate as determined by the meter. (auth)

8280 CIRCUIT BREAKER DEVICE ACTIVATED BY AN IONIZATION DETECTOR. Langeron, R. J. French Patent 2,124,134. 22 Sep 1972. Filed date 9 Feb 1971. 8p. (In French).

An automatic circuit breaking device activated by an ionization detector, which can be constructed in a compact easily used form, is presented. The device enables the state (open or closed) of an electric, electronic, electropneumatic, or electrofluidic circuit to be altered in the case of a malfunctioning detected by the ionization detector, i.e., following the release of smoke, gas or aerosols. (FR)

8281 IONIZATION DETECTOR DEVICE FOR THE SELECTIVE DETECTION OF SMOKE, GAS, AND AEROSOLS. Langeron, R. J. French Patent 2,124,074. 22 Sep 1972. Filed date 3 Feb 1971. 4p. (In French).

A device for selectively detecting smoke, gas, and aerosols is presented. The device includes an ionization detector for the detection of the smoke, gas, or aerosol released from the parts or elements being surveyed, these parts or elements having previously been treated with an appropriate smoke-producing substance. (FR)

8282 DETERMINING OPTIMUM CONDITIONS FOR MEASURING GAMMA RAY BACKSCATTERING. Seda, J.; Musilek, L. (Technical Univ., Prague). Isotopenpraxis; 8: No. 11-12, 440-444 (1972).

The calculation of the optimal thickness of the measured material from the point of view of measurement error is discussed. The minimum relative error of a measurement is determined as a function of the gamma radiation linear attenuation coefficient and the thickness of the material used. Various types of fluctuations are considered and attention is given to the background detected in the same arrangement without measured material. The results are summarized in simple figures. It is concluded that the optimal thickness increases with poorer quality of the measuring instrument. (auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 8775 and 8817.

8283 (AD-745992) REAL TIME EFFECTS OF SPACE AND NUCLEAR ENVIRONMENTS ON LITHIUM-DOPED CELLS. Final Report. Briggs, D. C.; Pollard, H. E.; Peterson, D. G. (Philco-Ford Corp., Palo Alto, Calif. (USA). Western Development Labs. Div). Jul 1972. Contract F33615-70C-1207. 174p. (WDL-TR-5028; AFAPL-TR-72-44). NTIS.

Lithium-doped silicon solar cells were irradiated at a real-time rate, with ^{90}Sr simulating the trapped electron environment. The irradiation was performed for a one-year period in a vacuum chamber. Four types of lithium cells and one type of conventional N/P cell were controlled to temperatures typical of normal satellite operational conditions. At the six-month point, the cells were exposed to a pulsed neutron environment simulating a nuclear weapon detonation. The experiment was successful in providing high quality data characterizing the comparative performance of several solar cell types. Conventional N/P cells outperformed lithium cells in the non-weapon environment and are recommended for all missions without hardening requirements. (auth)

8284 (AD-754905) INVESTIGATION OF RADIATION-INDUCED DEFECTS IN SILICON p–n JUNCTIONS. Final Report, 1 May 1971–31 August 1972. Buehler, M. G. (Texas Instruments Inc., Dallas). 1 Sep 1972. Contract F19628-71-C-0192. 64p. (TI-03-72-106; AFCRL-72-578). NTIS.

The investigation characterized electron- and neutron-induced defects in silicon pn junctions. Both p (+)n and n (+)p junctions were fabricated in various (111) silicon substrates which included homogeneous, $SiCl_4$ epitaxial, and SiH_4 epitaxial material. Defects were characterized between liquid nitrogen and room temperatures, using thermally stimulated junction measurements. (auth)

8285 (LYCEN-7276) IRRADIATION OF BIPOLAR TRANSISTORS IN THE 10^{12} RAD/SEC RANGE USING ELECTRON PULSES. Gaillard, R.; Genre, R. (Lyon Univ. (France). Institut de Physique Nucleaire). Dec 1972. 26p. (In French). Dep. NTIS (U.S. Sales Only) $3.50.

The experiments described were carried out using electron pulses from a Febetron. In this way, doses as high as $5 \cdot 10^{12}$ rad/sec were reached for surfaces of 0.15 cm^2. It was found that the triggering of anomalous photocurrents in npn transistors occurs at smaller collector-base potentials for higher doses than 10^{10} rad/sec. The usefulness of pnp transistors in circuits operating at high doses insensitive to avalanche injection phenomena is emphasized. (FR)

8286 (N-73-16031) EFFECTS OF PROTON IRRADIATION AND TEMPERATURE ON 1 OHM-CM AND 10 OHM-CM SILICON SOLAR CELLS. Nicoletta, C. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jan 1973. 42p. (NASA-TM-X-66169; X-765-73-25). NTIS.

The 1 ohm-cm and 10 ohm-cm silicon solar cells were exposed to 1.0 MeV protons at a fixed flux of 10^9 P/sq cm-sec and fluences of 10^{10}, 10^{11}, 10^{12}, and 3×10^{12} P/sq cm, I-V curves of the cells were made at room temperature, 65 and 165°C after each irradiation. A value of 139.5 mw/sq cm was taken as AMO incident energy rate per unit area. Degradation occurred for both uncovered 1 ohm-cm and 10 ohm-cm cells. Efficiencies are generally higher than those of comparable U. S. cells tested earlier. Damage (loss in maximum power efficiency) with proton fluence is somewhat higher for 10 ohm-cm cells, measured at the three temperatures, for fluences above 2×10^{11} P/sq cm. Cell efficiency, as expected, changes drastically with temperature. (auth)

8287 EFFECTS OF ELECTRON IRRADIATION ON OPERATIONAL AMPLIFIERS. Stanley, A. G.; McKenzie, P. F. (Massachusetts Inst. of Tech., Lexington). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS 20: No. 2, 100-107 (Apr 1973).

Second generation operational amplifiers, which are widely used in space applications, show considerable sensitivity to electron irradiation at fluences corresponding to unshielded long term operation in the earth synchronous orbit. Surface and bulk radiation effects are described for different device types. It is shown that the surface effects are very process dependent. Guidelines are given for the selection of reasonably radiation resistant components. (auth)

8288 SPACE–TIME STRUCTURE OF RADIATION OF A RUBY LASER SUBJECTED TO GAMMA IRRADIATION. Arifov,

U. A.; Bedilov, M. R.; Egamov, U.; Khaidarov, K. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 11, 22-24(1972). (In Russian).

The effect of γ-rays (source not specified) on the space–time structure of ruby laser radiation operating in a free regime was investigated. The laser radiation consisted of densely arranged bundles continuing for ~250 μsec with spacing of up to 25 μsec. A complex structure with many modes of vibration was present. Beginning with a dose of 10^4 R, the duration decreased, but the complex structure was preserved. At 10^4 to 10^7 R a contraction of the structure occurred, accompanied by a reduction in intensity. (KSW)

Miscellaneous Instruments

Refer also to abstracts 9219, 10007, 10008, 10146, and 10147.

8289 (EURFNR-1079) SEDAP: AN INTEGRATED SYSTEM FOR EXPERIMENTAL DATA PROCESSING. Audoux, M.; Katz, F. W.; Olbrich, W.; Schlechtendahl, E. G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan 1973. 250p. (KFK-1594; EUR-4730). Dep. NTIS (U. S. Sales Only) $14.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

A system for experimental data processing (SEDAP) provides the scientist with a powerful tool to process various digital data which are sampled during an experiment. SEDAP is a software package based upon FORTRAN IV and implemented on the IBM 360 and 370 installations of the Karlsruhe Nuclear Research Center. The system insures the modular processing of "experimental records" and provides a straightforward way to use standard operators (integration, conversion, plot... etc....). The leading principle in designing SEDAP was to allow experimenters who are not familiar with a programming language to conduct their own data reduction with the help of a very simple processing language. The approach which was selected to solve the problem of the experimental data processing is explained. The concept of "experimental record" is described. The detailed description of the system includes the storage management, the main program, the various operators, the different subsystems (transfer, input-output and service) and the interpretation of errors. 22 references. (auth)

8290 (RDT-P-2-6-T(12-72)) UNDERVOLTAGE RELAY FOR PLANT PROTECTION SYSTEM USE. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Dec 1972. 11p. RSO.

This standard establishes the requirements for the design, manufacturing, testing and quality assurance of undervoltage relays. These relays are Plant Protection System (PPS) equipment and are therefore "Class I Electric Equipment" as defined in IEEE 380. (auth)

8291 CAMAC INSTRUMENTATION SYSTEM: INTRODUCTION AND GENERAL DESCRIPTION. Costrell, L. (National Bureau of Standards, Washington, DC). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 3-8(Apr 1973).

The CAMAC instrumentation system developed by the ESONE Committee of European laboratories has been endorsed by the U. S. AEC NIM Committee as a dataway system complementary to the NIM (Nuclear Instrument Module) system. CAMAC is described in a general way in this introductory paper which is an updated version of the introductory paper that appeared in the April 1971 IEEE Transactions on Nuclear Science. (auth)

8292 OPERATIONAL CHARACTERISTICS OF THE CAMAC DATAWAY. Kirsten, F. A. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 9-20(Apr 1973).

The basic purpose of CAMAC is to provide a standardized method for transferring data and control information between instrumentation modules and a digital controller. CAMAC encompasses both a hardware standard for housing the modular components of a system and an electrical and logical standard for the control "language" used to effect the information transfer. The CAMAC specification contains the formally stated rules for both of these aspects of CAMAC. The control language and some of its features and uses are described in a less formal way than in the specification, and therefore may be useful as an introduction to the subject. (auth)

8293 SHORT DESCRIPTION OF THE CAMAC BRANCH HIGHWAY. Kirsten, F. A. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 21-27(Apr 1973).

A short summary and description of the CAMAC Branch Highway is presented. The purpose of the branch and some of its characteristics are explained. Certain operational sequences are described in detail. (auth)

8294 CAMAC DATAWAY AND BRANCH HIGHWAY SIGNAL STANDARDS. Larsen, R. S. (Stanford Univ., CA). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 28-34 (Apr 1973).

The voltage, current, and some timing characteristics of CAMAC Dataway and Branch Highway signals are described. (TFD)

8295 CAMAC CRATE CONTROLLER TYPE A-1. Dhawan, S. (Yale Univ., New Haven). Contract AT(11-1)3075. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 35-41(Apr 1973). (COO-3075-37).

A Crate Controller serves as a passive buffer or a communication link between the dataway and the Branch Highway. This Crate Controller is specified for use with a parallel Branch Highway. The Crate Controller Type A (CCA) is specified in EUR 4600e (1970). The EUR 4600e (1972) or TID-25876 has some changes to the CCA and is referred to as CCA-1. This Crate Controller has been very successful commercially and the current prices for this unit are very reasonable. (auth)

8296 ASPECTS OF CAMAC SOFTWARE. Thomas, R. F. Jr. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 50-68(Apr 1973).

Since most CAMAC systems include computers, the generation and maintenance of computer programs may represent a substantial fraction of the effort involved in assembling a CAMAC system. The effort involved can be reduced if standard software can be used, but the generality of the hardware and the variety of computers and interfaces make the production of efficient, general software difficult. Some of the problems and some general approaches to them are discussed. The NIM Software Working Group has been working on a set of FORTRAN subroutines for use with CAMAC systems. Though the effort is incomplete, it has reached a stage where its implementation is feasible and will prove useful. (auth)

8297 SUMMARY OF CAMAC: STATUS AND OUTLOOK. Mack, D. A. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 69-71(Apr 1973).

A general review of the development and uses of the CAMAC system is presented. (TFD)

8298 CHARACTERISTICS OF INTERFACES BETWEEN CAMAC AND SMALL COMPUTERS. Kirsten, F. A. (Univ. of California, Berkeley). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 42-49(Apr 1973).

The typical CAMAC system is operated in conjunction with a small computer. In the usual case, the computer acts as a repository for data generated by CAMAC, and also controls and directs the CAMAC operations. Some of the aspects of the hardware interface are discussed, and also some of the interaction between the computer and the CAMAC system. (auth)

8299 INSTRUMENTAL ASPECTS OF SECONDARY ION MASS SPECTROMETRY AND SECONDARY ION IMAGING MASS SPECTROMETRY. Werner, H. W. (Philips Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). Vacuum; 22: No. 11, 613-617 (Nov 1972).

A short survey of the varieties of the Secondary Ion Mass Spectrometry (SIMS) known at present is given. The principle of quantitative analysis with respect to thin film analysis is discussed. The properties of SIMS and SIIMS (Secondary Ion Imaging Mass Spectrometry) are compared with those of Electron Microprobe Analysis. Results of an analysis of a thin film of titanium oxide and of an Fe–Mn ferrite by means of SIMS and SIIMS are given. (auth)

8300 MASS SPECTROMETER WITH TROCHOIDAL ION BEAM. II. Apparatus. Ioanoviciu, D.; Mercea, V.; Cuna, C.; Ardelean, P. (Inst. for Stable Isotopes, Cluj). Rev. Roum. Phys.; 18: No. 1, 75-80(1973).

A 180° deflecting wedge field mass spectrometer is described. Details on the vacuum system, sample introduction, ion source, collector and deflecting magnet are given. A resolving power of 1340 was attained at current intensities utilizable for analytical work. The maximum collected H_2^+ current was 5.5×10^{-9} A. (auth)

8301 AUTOMATIC MASS SPECTROMETER FOR DEUTERIUM ANALYSIS IN DYNAMICAL REGIME. Pascalau, M. (Inst. of Stable Isotopes, Cluj). Rev. Roum. Phys.; 18: No. 1, 129-131 (1973).

The continuous determination of the relative variations of isotopic concentration in a separation process and the possibility of

an automatical control of this process can be assured by a mass spectrometer capable of measuring in a continuous form their variation without external intervention. It can be used, at the same time, for the measurement of the hydrogen deuterated samples, or of the liquid hydrogenated compounds. The mass spectrometer has been designed in order to satisfy this purpose. (auth)

8302 BLOCK DIAPHRAGM FOR THE LOCALIZATION OF RADIATION. Scheininger, L. (to Siemens AG). German Patent 1,564,765. 8 Mar 1973. Filed date 8 Jan 1970. 7p. (In German).

A block diaphragm for the variable rectangular localization of a radiation beam from a radiation source is described. It consists of four blocks of radiation-absorbing material which adjoin each other in a square and of an adjusting device for the blocks which makes it possible to alter the distance of the blocks opposite each other with synchronization of the other two blocks. The block surface serving for the localization of the block aperture is aligned in the normal manner to the radiation source. Each block is suspended by rigid links. The swivel point of this link is in the immediate vicinity of the radiation source. Each block is movable around two axes perpendicular to each other by means of this link. (JSR)

8303 ABSTRACT CALIBRATION OF APOLLO LUNAR ORBITAL MASS SPECTROMETER. Yeager, P. R.; Smith, A. (NASA Langley Research Center, Hampton, Virginia 23365); Jackson, J. J.; Hoffman, J. H. J. Vac. Sci. Technol. 10: No. 2, 348-354 (Mar 1973).

Recent experiments were conducted in Langley Research Center's molecular beam system to perform an absolute calibration of the lunar orbital mass spectrometer which was flown on the Apollo 15 and 16 missions. Tests were performed with several models of the instrument using two test gases, argon and neon, in the 10^{-13}–10^{-9} Torr range. Sensitivity to argon at spacecraft orbital velocity was 2.8×10^{-4} A/Torr enabling partial pressures in the 10^{-14} Torr range to be measured at the spacecraft altitude. Neon sensitivity was nearly a factor of 5 less. The response of the instrument to off-axis beams shows a cosine-to-cosine^2 dependence. Test data support the feasibility of using the lunar orbital mass spectrometer as a tool to gather information about the lunar atmosphere. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 7926.

8304 (CONF-730618-1) PROCESS EFFICIENCIES IN CALUTRON SEPARATIONS. Love, L. O. (Oak Ridge National Lab., Tenn.). [nd]. 17p. Dep. NTIS $3.00.

From eighth international electromagnetic isotope separator conference; Skovde, Sweden (12 Jun 1973).

A comprehensive review of the process efficiencies achieved with the ORNL calutron for all elements that involved over 40,000 runs and consumed nearly 3 million hours operating time is presented. (TFD)

8305 (KFK-1776) PROCESS SCHEME AND GENERAL INSTRUCTIONS FOR BUILDING A TECHNICAL SEPARATION NOZZLE CASCADE FOR URANIUM-235 ENRICHMENT. Luecke, R.; Weis, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Kernverfahrenstechnik). Mar 1973. 34p. (In German). Dep. NTIS (U.S. Sales Only $3.75.

Thesis. Submitted by F Luecke to Technische Hochschule, Karlsruhe (West Germany).

The separation nozzle process for uranium-235 enrichment, as any other known process, will generate in one stage only a small fraction of the concentration of 3% uranium-235 used for fission reactors. To reach this concentration it is necessary to build a cascade of several hundreds of separation units. The process scheme of separation nozzle cascade is shown for different UF_6-cuts θ_u and for the three possible coordinations of compressor and separation unit within a compact separation nozzle stage. General instructions are given by one coordination of compressor and separation unit and the UF_6-cut $\theta_u = 1/3$ for building up a technical separation nozzle cascade. Both operating aspects, such as the first assembly and maintenance, and safety aspects resulting from the possible use of the combustible hydrogen as an additional light gas are taken into account. (auth)

8306 (KFK-1777) ELECTROFORMING METHOD FOR PRODUCTION OF SEPARATION NOZZLE ELEMENTS FOR THE ENRICHMENT OF URANIUM-235. Happe, P.; Weis, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Kernverfahrenstechnik). Mar 1973. 36p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

Thesis. Submitted by P. Happe to Technische Hochschule, Karlsruhe (West Germany).

The separation nozzle process for the enrichment of ^{235}U requires slot-shaped separation nozzle elements with slot-widths of about 20 μm. A method for the mass-production of such elements by a combination of electroforming and milling with diamond tools is described. For demonstration of the efficiency of this method a sample series of nozzle elements was produced and examined under process conditions. The highest elementary effect of separation of the uranium isotopes obtained with the sample series amounted to 95% of the value reached in a dimensionally exact laboratory nozzle element. This allows the conclusion that the variation of the slot-widths in the sample series was about ±4 μm. Finally, an estimate of the necessary production time and cost for the mass-production of the separation nozzle elements leads to an optimum size of the manufacturing unit. Its yearly production capacity amounts to about 150 km of effective slot-length, which allows a separation work capacity of 115 tons of uranium/y to be installed. (auth)

8307 NEW USAEC CRITERIA FOR ENRICHMENT CONTRACTS. Braatz, U. (Uran-Isotopentrennungs GmbH, Juelich, Ger.). Atomwirt., Atomtech.; 18: No. 4, 171-172(1973). (In German).

A short description is given of the new conditions for toll enrichment. The main features of these conditions are long-term appointment, acceptance specifications, higher enrichment charges, and a current increase every half-year. (GE)

8308 DEVICE FOR ISOTOPE SEPARATION IN THE GASEOUS PHASE BY THE PRINCIPLE OF ISOTOPE SLUICE. Lamla, V. (to Gutehoffnungshuette Sterkrade AG). German Patent 1,544,029. 4 Nov 1971. Filed date 12 Mar 1970. 6p. (In German).

A device for isotope separation in the gaseous phase using the principle of the isotope sluice is described. The device has several diaphragms in a vacuum tight housing. The diaphragms are partially fixed and partially rotary. The diaphragm system is between inlet and discharge chambers for the delivery of the crude gas and discharge of the separated gas. All diaphragms are built as double-walled plane ring targets with at least one hollow space lying between them. The diaphragms are connected with the housing or are fixed to a rotary shaft. The side walls of the diaphragm are provided with slits. The stationary diaphragms are connected with chambers alternately for the intake of the crude gas or for the discharge of the light gas and the rotary diaphragms are connected with chambers for the discharge of the heavy gas. (JSR)

8309 CENTRIFUGE ENRICHMENT FOR UNITED KINGDOM NUCLEAR FUEL. Peirson, D. E. H. (Gesellschaft fuer Centrifugentechnik mbH, Bensberg, Ger.). Kerntechnik; 15: No. 4, 160-161(1973).

The capacity of the Western countries' enrichment plants will be insufficient to meet demand after 1982, even allowing for stockpiling pre-production quantities and the expansion of U. S. output. The gas centrifuge technology now being exploited by the United Kingdom, the Netherlands, and West Germany will create further capacity to meet the enriched uranium requirements of these three countries and other nations as well. Present plans provide some 2,000 t separative work per year on line by 1980 and 10,000 t SW per year by 1985. (GE)

Isotopic Power Sources

8310 (COO-2208-3) AVAILABLE SPACE FOR A TOTALLY IMPLANTABLE CARDIAC PROSTHESIS. Progress Report, July 1, 1972–March 31, 1973. Nose, Y. (Cleveland Clinic Foundation, Ohio (USA). Dept. of Artificial Organs). 1973. Contract AT(11-1)-2208. 55p. Dep. NTIS $4.75.

The goal of the present program is to define the spatial constraints of the body for a totally implantable radioisotope-powered cardiac prosthesis. The design is such that the prosthesis is compatible with both the human and the experimental animal, the calf. Most recent efforts were directed to the definition of the size and shape of the human thorax for implanting the blood pump. This was done by formulating a mathematical shape model from dimensions obtained from plastic molds made in the chest cavity of human cadavers. The shape model is used in conjunction with dimensions obtained from chest radiographs of living humans to arrive at a statistical distribution of chest dimensions. At present the shape model, being developed by computer, is nearly complete and over one-third of the radiographic data has been obtained. A parallel effort was to determine the anatomical and physiological tolerance of calves to implanted models of the thermal converter. Five calves were implanted with models; one case extrapleural, subcostal; one case intraperitoneal; three cases retroperitoneal, infrarenal. After over seven months of observation, all calves are in good physical condition with the retroperitoneal infrarenal space appearing to be most feasible. (auth)

8311 (N-72-18136) VACUUM DISTILLATION: VAPOR FILTERED–CATALYTIC-OXIDATION WATER RECLAMATION SYSTEM UTILIZING RADIOISOTOPES. Final Report, March 1969–June 1971. Honegger, R. J.; Remus, G. A.; Kurg, E. K. (General American Transportation Corp., Niles, Ill. General American Research Div.). Nov 1971. Contract F33615-69-C-1486. 69p. (NASA-CR-125675; GARD-1490-900; AMRL-TR-71-79). NTIS.

The development of a functional model water reclamation system is discussed. The system produces potable water by distillation from the urine and respiration–perspiration condensate at the normal rate generated by four men. Basic processes employed are vacuum distillation, vapor filtration, vapor phase catalytic oxidation, and condensation. The system is designed to use four 75-watt isotope heaters for distillation thermal input, and one 45-watt isotope for the catalytic oxidation unit. The system is capable of collecting and storing urine, and provides for stabilizing the urine by chemical pretreatment. The functional model system is designed for operation in a weightless condition with liquid-vapor phase separators for the evaporator still, and centrifugal separators for urine collection and vapor condensation. The system provides for storing and dispensing reclaimed potable water. The system operates in a batch mode for 40 days, with urine residues accumulating in the evaporator. The evaporator still and residue are removed to storage and replaced with a fresh still for the next 40-day period. (STAR)

Radiation Sources

Refer also to abstract 7884.

8312 IMPORTANCE OF NUCLEAR REACTORS FOR MEDICAL RESEARCH AND CLINICAL PRACTICE. Lorenz, W. J. (Inst. for Nuclear Medicine, Heidelberg). Theor. Klin. Med. Einzeldarstell.; 53: 1-99(1970). (In German).

A brief description of the TRIGA Mark-1-Heidelberg reactor (250 kWh) is followed by a review of the fields of application in the Cancer Research Center: nuclear medicine (diagnosis and therapy using short-lived radioisotopes), trace element and tracer investigations by means of neutron activation analysis, radiobiological and dosimetric investigations, in-vivo activation studies, activation autoradiography, and neutron therapy. (GE)

8313 CHECKING DOSIMETRY ACCURACY BY POST. Eisenlohr, H.; Abedin-Zadeh, R. Int. At. Energy Agency Bull.; 15: No. 2, 40-43(1973).

Both the IAEA and WHO have long been aware of the need for improved dosimetry in radiotherapy, and for other medical applications of radiation. In order to improve the accuracy of dosimetry, the IAEA set up a postal dose intercomparison service for ^{60}Co radiation, utilizing thermoluminescent lithium fluoride (LiF) powder as dosimetry substance. This survey has shown that in many countries the state of radiotherapy is not as good as it should be to achieve optimal results. It is difficult, however, to ascertain the real cause, or causes, of the sometimes rather poor results in big centers. Technical shortcomings might be one reason, but a more likely factor is the lack of appropriately trained personnel (medical physicists), and the lack of awareness on the users' side of the need for good dosimetry. (ERB)

Design and Fabrication

8314 MODELS OF HIGHLY ACTIVE MOESSBAUER ^{60}Co SOURCES. Godovikov, S. K.; Kuz'min, R. N.; Politova, E. D. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 13: No. 6, 655-658 (1972). (In Russian).

A detailed evaluation of model parameters was made for highly active Moessbauer sources CoBe, CoAl, CoSi, CoCr, and CoRh as proposed by various workers. The relationship of the parameters to physical properties of the matrix is discussed. (tr-auth)

8315 SAFETY DEVICE FOR THE CONTAINMENT OF A RADIOACTIVE SOURCE INTENDED FOR GAMMA RADIOGRAPHY. Mercier, A. (to Compagnie Generale de Radiologie). French Patent 2,118,849. 4 Aug 1972. Filed date 22 Dec 1970. 7p. (In French).

A safety device intended for a radioactive source container is presented. The container consists of a heavy metal shielding provided with an enclosure for housing the capsule containing the source. This capsule is fixed at the end of a source-holder. A heavy metal door is positioned in front of the enclosure. This door is provided with a lock which is controlled by the source-holder capsule in such a way as to immobilize the door when the capsule is outside of the enclosure. (FR)

Industrial Uses

Refer also to abstracts 8322, 8324, 8359–8361, 8369, 8373, and 8375.

8316 (KFK-1638, pp 127-134) PNEUMATIC ISOTOPE IRRADIATION FACILITY OF THE FEDERAL BUREAU FOR CIVIL POPULATION PROTECTION. Hardt, H. J. (Bundesamt fuer Zivilen Bevoelkerungsschutz, Bonn). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

For radiation experiments and for testing of measuring devices, the Federal Bureau for Civil Population Protection uses eight different sources of ^{137}Cs and ^{60}Co which are moved into radiation position through air pressure. The strongest sources have activities of 100 Ci ^{137}Cs and 5 Ci ^{60}Co, respectively. Operations are largely automated. Sample selection and control of distance are handled from a switchboard behind a radiation protection wall; observation of experiments is possible through television. The radiation protection is designed in such a way as to make only the experimental room a controlled area. For energy-dependent experiments, a largely automated x-ray installation is also evaluated. (HBG)

8317 MEASUREMENT OF DISTRIBUTION OF CHARGED METAL IN THE MOLD BY ACTIVABLE TRACER METHOD. Kawamoto, J. I.; Ito, Y. (Toyota Central Research and Development Lab., Inc., Nagoya, Japan). Radioisotopes (Tokyo); 21: No. 8, 482-486(Aug 1972). (In Japanese).

The distribution of molten metal in a mold was investigated by the activable tracer method, with a real casting part. Au and Ir were used as the tracer elements, which were not originally included in the casting material and highly sensitive to the neutron activation method. In the preliminary experiment with a simpler mold, it was revealed that 0.005% addition was sufficient for either Au or Ir to be fully detected after 5 h irradiation with a neutron flux of 2×10^{11} n/cm^2/sec, followed by 24 h of cooling and that the sampling for radiation detection should be carefully made because of incomplete mixing state of molten metal even in a preferred area. The mold in the experiment was a sand mold for the production of a cylinder head of an automotive engine. Molten metal was poured in three charges. The first charge contained Au, the second Ir and the third no tracer. About 10 g of sample was taken from each appropriate part of the casting, and subjected to the irradiation by neutrons with a flux of 2×10^{11} n/cm^2/sec. The content (in percent) of the first and second charges was determined from the measurement of the photo-peak area of gamma-rays at 0.41 (Au) and 0.31 (Ir) MeV, respectively. The remainder was assigned to the third charge. From these observations, it was found that the first charge settled in the lower part in the mold, farthest from the sprue runner. The second and third charges tended to solidify in more upper layers. However, in some portions in the mold was definitely observed some degree of mixing by convection. (auth)

8318 METHOD FOR THE IRRADIATION OF FOOD, CONDIMENTS, PHARMACEUTICALS, MEDICAL SUPPLIES, AND THE LIKE AND PACKING FOR CARRYING OUT THE METHOD. Brunner, W. (to Gebr. Sulzer AG). German Patent 1,813,965. 18 Jun 1970. Filed date 11 Dec 1968. 14p. (In German).

A method is described for the irradiation of food and condiments, pharmaceuticals, medical supplies, and the like. The goods to be irradiated are packed in an airtight container and exposed to ionizing radiation, preferably γ radiation. At the interior of the packing for the material to be irradiated, the existing gases are brought in contact with an agent capable of combining the oxygen chemically and physically. The combining capacity is increased by the irradiation. Silica gel is used as the oxygen-combining agent. An oxygen-combining agent is used which, because of its small-particle and/or porous structure, has an increased surface. The oxygen-combining agent is introduced inside a suitable gas-permeable container. The gas-permeable container is connected with the interior of the gas impermeable container for the material to be irradiated. The oxygen-combining agent is introduced into the gas impermeable container which is opened immediately after the sealing of the airtight container. The interior of the gas impermeable container is coated with the oxygen-combining agent. The oxygen-combining agent is deposited in gas permeable foils with which the airtight container is coated. (J.S.R.)

8319 INVESTIGATION OF THE SOLIDIFICATION PROCESS DURING CONTINUOUS CASTING THROUGH RADIOACTIVE ISOTOPES. Holzhey, J. (Forschungsinstitut fuer NE-Metalle, Freiburg i. B.); Goldmann, M. Isotopenpraxis; 8: No. 11-12, 450-455(1972). (In German).

A radiometric method for determination of the depth and structure of the fluid solution during continuous casting is described. The problems of tracer choice and experimental setup, such as emitter preparation, steel labelling, sampling, sample processing and measurement are discussed. The yielded results are regarded by supplying an example. Finally, the main advantages and disadvantages of this method are compared. (auth)

8320 METHOD FOR THE PREPARATION OF POROUS MATERIAL. Krauch, C. H.; Sanner, A. (to Badische Anilin- and Soda-Fabrik Aktiengesellschaft). German Patent 1,809,610. 11 Jun 1970. Filed date 19 Nov 1968. 8p. (In German).

A method is described for the preparation of porous laminar material by saturation of laminar threads with liquids which contain high-molecular polymers and, if necessary, stabilizers in dissolved and/or dispersed form. The liquid-impregnated threads are cooled to temperatures at which the liquids solidify in a crystalline form at least partially. The partially crystallized solids are irradiated. The solvent is then thawed and separated. The liquids contain no olefin unsaturated monomers. (JSR)

8321 METHOD FOR THE PREPARATION OF SHAPED PIECES FROM VINYL ALCOHOL–OLEFIN COPOLYMERIDES WITH DISTINCTIVE IMPACT DUCTILITY. Yoshitake, T.; Imai, K.; Sogi, H.; Hirano, K. (to Kuraray Co., Ltd.). German Patent 1,570,847. 23 Dec 1971. Filed date 15 Mar 1965. 4p. (In German).

Powdered vinyl alcohol–olefin copolymerides are irradiated with ionizing radiation and combined with dien compounds, monomers containing dien compounds, or a solution with maintenance of the powdered form of the copolymerides. The copolymeride containing the grafted polymerides was molded by the fusion method either directly or after it was ground. (JSR)

LIFE SCIENCES

Radiation Effects on Biochemicals

8322 EFFECTS OF HEAT TREATMENT, UV, AND GAMMA RADIATION ON SOME BEET ROOT PIGMENTS. Aurstad, K.; Dahle, H. K. (Norges Veterinaerhoegskole, Oslo). Z. Lebensm. Untersuch. Forsch.; 151: No. 3, 171-174(1973).

The dominating red and yellow pigments from beetroot separated by paper electrophoresis, were exposed to various degrees of heat treatment, uv, and gamma irradiation. The present investigations indicate that under the given conditions, the isolated beetroot pigments are not sufficiently resistant to the physical treatments that may be expected during pasteurization of food products by heat or ionizing radiation. The pigment solutions had relatively greater absorbance in the lower region of their visible spectra after uv-light exposure, but the solutions lost some of their color and spectral characteristics. (GE)

8323 EFFECTS OF X-IRRADIATED HISTIDINE ON THE FORMATION OF THIOBARBITURIC ACID-REACTING MATERIAL IN NUCLEI ISOLATED FROM THE RAT THYMUS. Shima, A. (Tokyo Univ.). J. Fac. Sci., Univ. Tokyo, Sect. IV; 12: No. 1, 93-100(Dec 1970).

The formation of the thiobarbituric acid (TBA)-reacting material in irradiated thymus-homogenate or in isolated nuclei incubated in the presence of 5 mM histidine irradiated with 48 kR of x rays was examined, with the following results. Little TBA-reacting material was found in the homogenate immediately after irradiation with x-ray doses within the range from 0.5 to 4 kR. If, however, irradiated homogenates were incubated at 37°C for 60 min in air, a considerable increase in the TBA value was observed. When isolated nuclei were incubated with non-irradiated (controls) or irradiated histidine (experimentals), the amount of the TBA-reacting material in the nuclei increased, though slightly, with the incubation time, showing no significant difference between the controls and the experimentals. The TBA value in the surrounding medium of the nuclei, however, showed a marked difference between the controls and the experimentals. The TBA values for the experimentals began to increase 15 min after incubation, while the value for the controls did so at 45 min. It seems unlikely that the increased TBA value in the supernatant can be ascribed to the stimulated release by irradiated histidine of the TBA-reacting material itself from the nuclei. The possible mechanism of the effects of irradiated histidine on the nuclear metabolism has been discussed. (auth)

8324 STUDIES ON THE IDENTIFICATION OF IRRADIATED POTATOES. Part 4. Effect of X Rays on the Synthesis of Phenylalanin-ammonialyase in Potatoes. Shirsat, S.; Penner, H. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Lebensm.-Untersuch. Forsch.; 151: No. 3, 167-170(1973). (In German).

The effect of x rays on synthesis of phenylalanine-ammonialyase (PAL) in 22-hour-incubated slices of tuber parenchyma has been studied in 4 varieties of potatoes. In the variety Sieglinde a nearly linear decrease of PAL-activity with increasing doses of irradiation has been found. During a storage period of 3 months the PAL-activity decreases in irradiated and unirradiated tissue. The extent of PAL-synthesis depends on variety, duration of storage, irradiation dose and shows a high biological variation among potatoes treated in the same manner. The identification of irradiated potatoes seems to be possible after a dose of at least 15 krads if enough replicates are used and compared with controls. (GF)

8325 STIMULATION OF UBIQUINONE BIOSYNTHESIS IN IRRADIATED RATS. Aiyar, A. S.; Gopalaswamy, U. V.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). Environ. Physiol. Biochem.; 2: No. 2, 86-95(1972).

In fasted rats, whole-body x irradiation results in a 2 to 3 fold increase in the labeling of hepatic ubiquinone by 2-^{14}C-acetate both in vivo and in vitro. The incorporation of 2-^{14}C-mevalonate into liver ubiquinone is, however, not significantly altered in the irradiated rats. The activity of mevalonate: NADP oxido-reductase (E.C.1.1.1.34), the rate-limiting enzyme in isoprenoid biosynthesis, is elevated in livers of irradiated rats. Studies on incorporation of U-^{14}C-benzoic acid and $CH_3-{}^{14}C$-methionine by liver slices from irradiated rats into the ring moiety of ubiquinone also reveal a similar increase; this appears to result from enhanced formation of the side chain. The stimulation of ubiquinone biosynthesis due to radio-exposure is also seen in rats previously fed cholesterol, which is known to exert a feed-back inhibition on isoprenoid biosynthesis. Administration of cycloheximide, an inhibitor of protein synthesis, abolishes the radiation-induced increase in the labeling of hepatic ubiquinone by ^{14}C-acetate. These results suggest that ubiquinone in the irradiated rat is stimulated owing to increased synthesis of mevalonate: NADP oxidoreductase, the rate-limiting enzyme. (auth)

8326 STIMULATING EFFECT IN UV IRRADIATION OF BAC. SUBTILIS TRANSFORMING DNA. Minkova, M. I. (Inst. of Radiology and Radiation Hygiene, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 1, 125-128(1973).

The radiosensitivity of transforming DNA as a function of dose was studied by following the inactivation of tryptophan independence marker in uv-irradiated solutions of either purified or protein-containing DNA from Bacillus subtilis. An increase in the transforming capacity of nondeproteinized DNA was observed following irradiation. Such increase was not observed in the protein-free DNA following irradiation. (ERB)

8327 INHIBITORY EFFECTS OF X-IRRADIATED HISTIDINE ON PROTEIN SYNTHESIS IN ISOLATED THYMUS NUCLEI. Shima, A. (Tokyo Univ.). J. Fac. Sci., Univ. Tokyo, Sect. IV; 12: No. 1, 75-82(Dec 1970).

The inhibitory effects of x-irradiated histidine on the incorporation of ^{14}C-amino acids into isolated rat thymus nuclei were studied by fractionating the nuclear materials into four fractions: the deoxycholate-soluble, water-soluble, M NaCl-soluble, and residual fractions. A rather uniform inhibition of amino acid incorporation was found in three of the fractions examined, but in the DOC-soluble fraction the inhibition was not so marked. No effects of x-irradiated histidine were observed in the translocation of once-incorporated amino acids in the nuclei. (auth)

8328 PROPERTIES OF DNA IRRADIATED IN THE PRESENCE OF THE PROTECTIVE AGENT BIS(2-GUANIDOETHYL) DISULPHIDE (GED). Leon, S. A.; Kollmann, G.; Shapiro, B. (Albert Einstein Medical Center, Philadelphia). Int. J. Radiat. Biol.; 23: No. 4, 325-332(Apr 1973).

Structural alterations were measured after gamma irradiation of dilute solutions of salmon-sperm DNA and were correlated with the enhancement of template activity at 7 KR, as well as its inhibition at higher exposures as previously described. Formation of single-stranded regions in irradiated DNA was demonstrated by measurements of hyperchromicity and T_m in the presence of formaldehyde, and by the rate and quantity of ^{14}C-formaldehyde binding. The radioprotective agent bis(2-guanidoethyl) disulphide (GED) showed little and marked protection against this damage at 7 KR and 28 KR, respectively. Ultracentrifugation analysis demonstrated the formation of double- and single-stranded breaks in a ratio of 1 : 6.5 without GED and 1 : 10 with GED at both 7 KR and 28 KR. It is concluded that enhancement of template activity at 7 KR is due to the production of single-stranded regions and single-stranded breaks that stimulate the activity of DNA polymerase. The protection of GED results in reducing the number of double-stranded breaks and other detrimental changes that inhibit template activity. At 28 KR and higher exposures, the protection is considerable but not complete, and the enhancement may be masked by an increasing number of double-stranded breaks and other changes that inhibit template activity. (auth)

8329 EFFECTS OF IRRADIATION ON HUMAN SERUM TRANSFERRIN. Miller, R. J. (Univ. of Illinois, Chicago); Bezkorovainy, A. Radiat. Res.; 54: No. 2, 212-221(May 1973).

Iron-free and iron-saturated human serum transferrins were irradiated at doses of $1-10 \times 10^6$ rads, and the resulting changes in their physical parameters were measured. It was found that tyrosyl groups and disulfide bonds were perturbed at the lowest levels of irradiation. Next, a perturbation of the iron-binding site was observed. Gross denaturation and aggregation of the protein molecules was observed only at the highest doses of irradiation. The effects of irradiation on the iron-binding sites were retarded by the presence of the iron therein, which possibly acted as an energy sink. (auth)

8330 EFFECT OF X-IRRADIATED HISTIDINE ON THE IN VITRO INCORPORATION OF LABELED AMINO ACIDS INTO THE ACID-SOLUBLE AND ACID-INSOLUBLE FRACTIONS OF NUCLEI ISOLATED FROM THE RAT THYMUS. Shima, A. (Tokyo Univ.). J. Fac. Sci., Univ. Tokyo, Sect. IV; 12: No. 1, 83-92(1970).

The effects of x-irradiated histidine (48 kR, 5 mM) on the incorporation of amino acids into nuclear material of the rat thymus were studied. The uptake of ^{14}C-Chlorella amino acids by the whole nuclei was lowered by irradiated histidine. The degree of the inhibition of amino acid uptake by the acid-insoluable material was greater than that found in the case of the acid-soluble fraction. The

release of labelled amino acids from the acid-soluble fraction of the nucleus was not affected by the presence of irradiated histidine. An inhibitory effect of irradiated histidine on amino-acid transport was observed with metabolizable amino acid, L-alanine-^{3}H, and with non-metabolizable α-aminoisobutyric-1-^{14}C acid. It seems unlikely that the depression by the irradiated histidine of amino-acid transport is responsible for the observed decrease in the protein synthesis. (auth)

8331 EFFECT OF IONIZING RADIATIONS OF HAEMOGLOBIN OF A TUBIFICID WORM TUBIFEX SP. Patel, S.; Patel, B. (Bhabha Atomic Research Centre, Bombay). pp 487-497 of Radioactive Contamination of the Marine Environment. Vienna: International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

The effect of ionizing radiation on the extracellular hemoglobin (molecular weight 3×10^{6}) of a tubificid worm Tubifex sp. with special reference to the role of a sulphydryl protector (AET) was studied. The radiation effect was studied spectrophotometrically by measuring the changes in the absorption spectra following in vitro exposure to a ^{60}Co γ source. Oxyhemoglobin solutions on exposure to ionizing radiations showed a general decrease in absorption at 540, 574, and 414 nm peaks. However, the absorption in ultraviolet at 278 nm increased. The effect was dose dependent from 69 to 276 kR. The radiation effects were similar to those exhibited by extracellular hemoglobin of a marine polychaete worm Marphysa mossembica, and was more resistant in the sense that it was less easily oxidized than the extracellular hemoglobin of a false cockle Cardita antiquata. In general, the extracellular hemoglobins of Tubifex sp., Marphysa mossambica, and Cardita antiquata were much more radioresistant and could be exposed to a dose as high as 300 kR compared with erythrocytic hemoglobins of ark-shells Anadara granosa and Scapharca deyrollei subsp. crispi, which precipitated on exposure to doses exceeding 18 and 1.2 kR, respectively. The physiological implications of the effect of ionizing radiations are discussed in relation to its ecology, and compared with the hemoglobins of other invertebrates. (auth)

8332 EFFECT OF INHIBITORS OF OXIDATIVE PHOSPHORYLATION ON STEROL PRODUCTION IN YEAST ORGANISMS. Gal'tsova, R. D.; Larikova, G. A.; Vakina, I. P. (Inst of Microbiology, Moscow). Mikrobiologiya; 41: No. 3, 389-394(1972). (In Russian).

The effect of some inhibitors of oxidative phosphorylation (sodium azide, sodium fluoride, salicylic acid, calcium cations) on sterol biosynthesis by yeast organisms was studied. The treatment of the yeast cells by these compounds caused the accumulation of sterol in the cells. The combined effect of ionizing radiation and these compounds on the yeast cells, growing on the medium with a high content of carbohydrates, stimulated even more the accumulation of sterol in the yeast organisms. (auth)

8333 REPAIR PROCESSES ON DEOXYRIBONUCLEIC ACID. Berndt, J. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). Angew. Chem. Int. Ed. Engl.; 12: No. 4, 264-273 (Apr 1973).

Many cells have the ability to recognize and eliminate damage to their DNA, particularly thymine dimers formed by uv light. The elimination of this damage may be achieved by enzymatic, light-dependent cleavage of the dimers into the monomers (photoreactivation) or more frequently by dark repair, in which the damaged part is completely removed from the DNA. In this repair process, the DNA is incised by an endonuclease in the immediate vicinity of the thymine dimers. Oligonucleotides containing the thymine dimer are removed hydrolytically from the DNA by the 5 → 3′ exonuclease activity of DNA polymerase I (Kornberg enzyme). The resulting gaps are immediately closed by a de novo synthesis with the aid of the same DNA polymerase I, the complementary strand serving as a template (excision repair). The final step is the formation of the phosphodiester bond between the newly synthesized DNA fragment and the old DNA strand by a DNA ligase. Xeroderma pigmentosum patients lack the endonuclease as a result of a genetic defect; they therefore cannot eliminate thymine dimers from their DNA, and are extremely sensitive to sunlight. All information so far suggests that genetic recombination and DNA repair are performed by the same enzyme system. (auth)

8334 PHOTOACTIVATION OF CHLORPROMAZINE: CYTOGENETIC AND MUTAGENIC EFFECTS. Kelly-Garvert, F.; Legator, M. S. (Food and Drug Administration, Washington, DC). Mutat. Res.; 21: No. 2, 101-105(Apr 1973).

The mutagenic and cytogenetic effects of chlorpromazine (CPZ), a tranquilizer of the phenothiazine class, was investigated in a Chinese hamster cell line. CPZ photoactivated by exposure to dark light uv caused an increase in the number of chromosome aberrations and mutation frequency ($HG-PRT^{+} \rightarrow HG-PRT^{-}$). CPZ without dark light exposure was inactive in this test system. (auth)

8335 DAMAGE TO THE STRUCTURE OF DNA IN THE TISSUES OF γ-IRRADIATED ANIMALS. Komolova, G. S.; Trifonov, E. N.; Egorov, I. A. (Inst. of Biochemistry, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 1, 248-250(1 Jan 1973). (In Russian).

Male Wistar rats were subjected to an LD_{50} dose of 650 R of ^{60}Co gamma radiation, with subsequent removal of the thymus and spleen after varying periods of time and study of the molecular weight of the DNA contained in these organs. The data showed that 15 min after irradiation there appeared 1.3 ± 0.4 defects per 10,000 nucleotide pairs. This quantity held fairly constant for the subsequent hour, and only after three hours increased noticeably. (KSW)

Radiation Effects on Cells

Refer also to abstract 8439.

8336 (JPRS-59015, pp 120-127) INVESTIGATION OF CHROMOSOMAL ABERRATIONS IN LYMPHOCYTES OF HUMAN PERIPHERAL BLOOD WITH IN VITRO EXPOSURE TO 645-MeV PROTONS AND X RAYS. Ryzhov, N. I.; Totseva, A. M.; Govorun, R. D.; Malyutina, T. S.; Gerasimenko, V. N. May 1973. Translated from Kosm. Biol. Med.; 7: No. 2, 79-83(1973).

Lymphocytes of the human peripheral blood in the presynthetic phase of the mitotic cycle were irradiated in vitro by 645 MeV protons in doses of 25 to 400 rad. The tabulated data reveal no differences in the induction of chromosomal aberrations by protons and x rays. (auth)

8337 (LA-5180-C, pp 44-49) BIOLOGICAL PROPERTIES. Whitmore, G. F. (Ontario Cancer Inst., Toronto). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2–5, 1972, Los Alamos Scientific Laboratory, New Mexico.

It is pointed out that the main objective of radiotherapy is the prevention of the proliferation of neoplastic cells. Data are reviewed from studies on cultured mammalian cells that illustrate some of the basic radiobiological features that must be considered in evaluating the effectiveness of charged particle beams for radiotherapy. Results are summarized from studies on the effects of LET, the age of cells in the cell cycle, the oxygen enhancement ratio, radiation quality, and dose fractionation schedule on the division rate and survival of cells exposed to conventional x and γ radiations, fast neutrons, negative pions, protons, and He ion beams. The advantages gained by improved dose distribution and reduction of the resistance of hypoxic tumor cells relative to the well oxygenated normal tissues surrounding the neoplasm by the use of charged particle beams for therapy are considered. (CH)

8338 (LA-5180-C, pp 108-112) OER AND CELL CYCLE. Berry, R. J. (Churchill Hospital Research Inst., Oxford). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2–5, 1972, Los Alamos Scientific Laboratory, New Mexico.

Data are summarized from studies on the effects of the oxygen enhancement ratio on the survival of cultured mammalian cells and murine leukemia cells exposed in vivo to fast neutrons, γ, or x radiation, and two cultured mammalian cell lines exposed to fast neutrons and negative π mesons. The relationship of LET to survival time was determined. It was concluded that the depth dose distribution of pion beams should be greatly superior to that of external photon or fast neutron beams for use for radiotherapy of deep seated neoplasms. (CH)

8339 (LA-5180-C, pp 113-119) CELLULAR ASPECTS OF DOSE FRACTIONATION AND RECOVERY IN PARTICLE RADIATION TREATMENTS. Todd, P. (Pennsylvania State Univ., University Park). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2–5, 1972, Los Alamos Scientific Laboratory, New Mexico.

Results are reviewed from studies on cultured mammalian cells that show that dose fractionation of charged particle beams has two effects. One effect is to change OER whether hypoxic cells recover or not. The other effect is to greatly modify depth-survival profiles to greatly improve cell survival outside the treatment zone. In order to take full advantage of the apparently attractive properties of particles for radiotherapy, protocol design must include con-

sideration of the effects of fractionation on OER and depth-damage profile. (CH)

8340 RADIATION EFFECTS ON CALLUS-FORMING CELLS DURING RESTING AND PROLIFERATIVE PHASES. Hayashi, S. (Kyoto Prefectural Univ.). Gan No Rinsho; 18: No. 9, 582-586 (Sep 1972). (In Japanese).

A literature review is presented of studies on radiation effects on callus-forming cells during the resting and proliferative phases of the cell cycle. With the non-irradiated callus size as the criterion, the radiosensitivity was correlated with the degree of decrease of the callus size. The radiosensitivity of the cells in the resting phase was lower than that of cells in the proliferative phase. The bone was fractured 24 hr after the second of two fractionated irradiations and recovery of sublethal damage was observed. The rate of recovery increased in proportion to the size of the first radiation dose. The recovery capacity was influenced by the partial pressure of oxygen at the site of the lesion and the OER was calculated. (HLW)

8341 RADIOSENSITIVITY OF BONE MARROW CELLS FORMING FIBROBLAST COLONIES IN MONOLAYER CULTURES. Kuzmenko, G. N.; Panasyuk, A. F.; Fridenshtein, A. Ya.; Kulagina, N. N. (Inst. of Epidemiology and Microbiology, Moscow). Byull. Eksp. Biol. Med.; 73: No. 10, 94-97(Oct 1972). (In Russian).

The radiosensitivity of bone marrow cells of guinea pigs, forming in the monolayer cultures colonies of fibroblasts, was determined. Cells in the suspension were irradiated in vitro before the explanation. Practically a complete depression of colony formation took place after the irradiation with a dose of 600 R and over. Depression of colony formation in the irradiated suspensions depended on the action on the colony-forming cells, not on the bone marrow cells which played in the cultures the role of natural feeders. The mean lethal dose or a 37% dose D_0 = 178 ± 15 R, and the extrapolarization number n = 1.44. (auth)

8342 RADIOSENSITIVITY IN MAMMALIAN CELLS. Ohara, H. (National Inst. of Radiological Sciences, Chiba, Japan). Gan No Rinsho; 18: No. 9, 578-581(Sep 1972). (In Japanese).

Current literature dealing with radiosensitivity of cultured cells is reviewed. Radioinduced chromosomal changes in radioresistant strains separated from L cells and leukemic P-388 cells of mice are discussed in particular. It is considered possible that dissociated cells with genetically affected radioresistance proliferated after selection of parent strains and developed into a new neoplasm. Changes in radioresistance within the cell cycle of HeLa cells and Chinese hamster cells are also discussed as well as their recovery rates. Oxygen pressure and SH level are considered changing factors of radiosensitivity of the cell. Reaction of the cell to irradiation under the condition of low oxygen pressure was described with reference to experiments using island forming strains of neoplasm in Chinese hamsters. In regard to the correlations between radioresistant cells and SH level, pertinent experiments in which SH levels were directly measured in HeLa cells are explained. (Japan)

8343 REPAIR REPLICATION IN X-IRRADIATED LYMPHOMA CELLS IN VITRO. Fox, M.; Fox, B. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 23: No. 4, 333-358(Apr 1973).

Repair replication using isopycnic CsCl density-gradient techniques was studied in P388 cells and in two lines of L5178Y lymphoblasts showing a large difference in radiosensitivity. The results indicate that in all three cell-lines only small numbers of bases <10 are insertion/damaged site. The radiosensitive L5178Y cell line consistently showed greater base insertion/damaged site than the radioresistant line and P388 cells. DNA of the two L5178Y cell-lines was equally sensitive to breakage by x irradiation, as shown by alkaline sucrose gradient sedimentation techniques. A component of DNA associated with a lipid containing material was identified that contaminates native DNA after all extraction procedures used. Characterization of this material suggests that it represents DNA attached to a membrane fraction. Such material when present may be mistaken for repair incorporation. The present data fit the generalization that only small numbers of bases are inserted/break and are in close agreement with those published by Painter and Young (Mutation Res.; 14: 225(1972)) for P388, B14FAF and W138 cells. (auth)

8344 REPAIR REPLICATION AFTER UV IRRADIATION IN RODENT CELL-LINES OF DIFFERENT SENSITIVITY. Fox, M.; Fox, B. W. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 23: No. 4, 359-376(Apr 1973).

Repair replication and unscheduled DNA synthesis were demonstrated in a number of cultured tumor cell-lines of rodent origin. The amount of repair replication observed was less than that observed in HeLa cells when the same labeling procedures were used. Ultraviolet-sensitive mutants of Yoshida cells that showed reduced D_0 value and an extrapolation number of 1 showed reduced repair replication. The uv-sensitive mutant of L5178Y cells that differed only in its extrapolation number showed the same amount of repair replication as its more resistant mutant. Results are presented that show the amount of repair replication in rodent cells is less than that in HeLa cells and that differences in amount of repair replication between two closely related cell lines are associated with changes in D_0 value but not with changes in shoulder size and extrapolation number. (auth)

8345 RADIOSENSITIZATION OF MAMMALIAN CELLS BY p-NITROACETOPHENONE. 3. Effectiveness of Nitrobenzene Analogues. Raleigh, J. A.; Chapman, J. D.; Borsa, J.; Kremers, W.; Reuvers, A. P. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Int. J. Radiat. Biol.; 23: No. 4, 377-387(Apr 1973).

Nitrobenzene analogues of p-nitroacetophenone (PNAP) were tested on Chinese-hamster cells for their ability to sensitive hypoxic cells to x rays. Seven compounds that are more effective than PNAP at a given non-toxic concentration are reported. One of these, 1-(2,4-dinitrophenyl) pyridinium chloride (DNPC), approaches the nitrofuran class of radiosensitizers in effectiveness. A correlation between cellular radiosensitization and drug electron affinity is examined for its usefulness in predicting radiosensitizing potential of compounds in the nitrobenzene series. (auth)

8346 LIFE-CYCLE DEPENDENCE OF REPAIR OF POTENTIALLY LETHAL RADIATION DAMAGE. Little, J. B. (Harvard School of Public Health, Boston); Hahn, G. M. Int. J. Radiat. Biol.; 23: No. 4, 401-407(Apr 1973).

Experiments were made to test the hypothesis that post-irradiation repair in mammalian cells occurs in the G_1 phase of the life cycle. Plateau-phase cultures of Chang human liver cells (LICH) and Chinese-hamster HA-1 cells (HA) were used, in which S phase cells were killed. X irradiation was over a range 1000 to 1500 R at a dose-rate of ~110 R/min, and repair of potentially lethal damage was assessed by comparing the survival in cultures subcultured immediately after irradiation with that found in cultures returned to the incubator for 6 hr. The results indicated that most, if not all of the enhanced survival found in cultures left in the plateau phase of growth for 6 hr after irradiation is due to repair occurring in the G_1 population. Also, in LICH cells where repair can be demonstrated during exponential growth, it also appeared to involve primarily G_1 cells. (UK)

8347 DOSE-RATE EFFECTS IN SYNCHRONOUS MAMMALIAN CELLS IN CULTURE. Bedford, J. S.; Mitchell, J. B. (Vanderbilt Univ., Nashville). Radiat. Res.; 54: No. 2, 316-327 (May 1973).

The life cycle and survival of synchronized HeLa and Chinese hamster cells were examined during continuous irradiation at dose rates of 38 or 90 rads per hour. The results indicate that over a given range of dose rates, life-cycle-related factors can play a significant role in what is commonly referred to as the dose-rate effect. Dose rates of 38 rads per hour for HeLa cells, and 90 rads per hour for V79 Chinese hamster cells essentially prevented cell division. Continuous irradiation had no effect on the progress of cells through G_1 or S, but produced a G_2 delay and prevented cell division. If the continuous irradiation was started just before mitosis, cell division was also prevented. Continuous irradiation at 38 rads per hour had no measurable effect on the life cycle or division of V79 cells during three successive generations. (auth)

8348 MORPHOLOGICAL MODIFICATIONS OF RAT GLIAL TUMOR CELLS AFTER X IRRADIATION. Heilporn, V.; Lievens, A.; Limbosch, S.; Zampetti-Bosseler, F.; Steinert, G. (Univ. Libre, Brussels). Radiat. Res.; 54: No. 2, 252-260(May 1973).

The formation of long cytoplasmic extrusions was observed in rat glial tumor cells after doses of 120, 300, and 600 R. This probably results from the assembly of microtubules, since colchicine prevents it; moreover, ultrastructural examination of the processes confirms the presence of microtubules and microfibrils. During the 3 days following a 300- or 600-R irradiation, i.e., at the time when the cytoplasmic extrusions appear, autoradiography shows that DNA and RNA syntheses are strongly inhibited, while protein synthesis is stimulated. The significance of these results is discussed. (auth)

8349 SENSITIZING EFFECT OF 5-BROMODEOXYURIDINE (BUdR) ON CHINESE HAMSTER CELLS, UV-IRRADIATED IN VITRO AT POSTSYNTHETIC PERIOD OF THE MITOTIC CYCLE. Safonova, G. M.; Myasova, Z. N.; Tarasov, V. A. (Inst. of General Genetics, Moscow). Genetika; 9: No. 3, 34-40(Mar 1973). (In Russian).

A sensitizing effect of BUdR upon its incorporation in chro-

mosomal DNA at the S-phase of the mitotic cycle was studied. It was shown that the presence of thymidine in the G_2-phase of the first cycle of cells, which incorporated BUdR at the point of replication, eliminated a sensitizing effect of BUdR at the exposed G_2-phase of the second cycle. (auth)

8350 REPAIR REPLICATION IN MAMMALIAN CELLS. Painter, R. B. pp 77-86 of DNA-Repair Mechanisms. Stuttgart; F. K. Schattauer Verlag (1972).

A review of the literature on repair replication of DNA in mammalian cells is presented. Topics discussed are: the chemical nature of DNA single-strand breaks; repair of DNA in mouse L cells exposed to various doses of x radiation; comparison of DNA damage induced by ionizing and ultraviolet radiation; and the role of repair replication in unirradiated cells. (HLW)

8351 CYTOGENETICS OF THE INITIAL STAGES OF CHROMOSOME RADIATION INJURY. Demin, Yu. S. (Inst. of Biology of Development, Moscow). Dokl. Akad. Nauk SSSR; 209: No. 2, 475-477(11 Mar 1973). (In Russian).

Chinese hamster (chromosome number 23-24) cells were given 150 R doses of x-rays in vitro, and chromosome destruction was noted at stages of the metaphase 0.5, 1, 1.5, 3, and 4 hr after irradiation. The frequency of all types of chromosomal disturbance 30 min after irradiation did not differ statistically from that of the controls. It was experimentally demonstrated that the formation of a structural mutation is a time-dependent process, for which all transitional stages have been examined. A comparison with the conclusions of other workers is made. (KSW)

8352 ULTRAVIOLET-INDUCED MUTATIONS TO ASPARAGINE INDEPENDENCE IN JENSEN SARCOMA CELLS IN VITRO. Vernick, D.; Morrow, J. (Univ. of Kansas, Lawrence). Mutat. Res.; 18: No. 2, 225-231(May 1973).

UV irradiation induces an exponential increase in the frequency of mutation from asparagine requirement to asparagine non-requirement in Jensen sarcoma cells grown in vitro. The corrected mutation frequency increases from the spontaneous rate of 5.1×10^{-6} per cell to 1248×10^{-6} per cell with a dose of 180 erg/mm^2 of 254 nm uv radiation. A substantial increase was observed even without correction for survivors, and no significant difference was observed in the uv sensitivity of asparagine-requiring and non-requiring Jensen clones. When Jensen cells were plated at low densities in a feeder layer of LMTK$^-$ cells inactivated by HAT medium, an increase in the cloning ability of the former was observed as compared to appropriate controls without the feeder layer, but the increase was constant over all doses of uv tested. Revertants are stable and possess measurable asparagine synthetase. It is concluded that uv is an extremely effective mutagen in this system. (auth)

8353 HETEROGENEOUS CHROMOSOMAL RADIOSENSITIVITY OF PHYTOHAEMAGGLUTININ-STIMULATED HUMAN BLOOD LYMPHOCYTES IN CULTURE. Steffen, J.; Michalowski, A. (Inst. of Oncology, Warsaw). Mutat. Res.; 17: No. 3, 367-376(Mar 1973).

Human blood lymphocytes were irradiated with hard x rays, stimulated with phytohaemagglutinin (PHA), and grown in presence of amethopterin to accumulate the responding cells at the GI/S boundary of the first cell cycle in vitro. After reversal of the GI/S block with exogenous thymidine, the frequencies of asymmetric chromosome exchanges in relation to the position of metaphases within the first generation mitotic wave were compared. Significant differences of aberration yields within replicate culture series were found in several experiments. A gradual increase of aberration frequencies with increasing duration of S + G2 phases was the most constant feature encountered. In addition, in two parallel series of cultures from one donor, the highest frequency of aberrations was found in samples corresponding to the shortest S + G2 phase duration. A significant contribution of selective mitotic delay of aberration-carrying cells to the distribution of aberration frequencies was excluded. Therefore, it was inferred that the results reflect a true variability of radiosensitivity among the PHA-responsive cells, probably of a discontinuous character, ranging over the ratio of two. (auth)

8354 CHROMOSOME ABERRATIONS AND RADIATION-INDUCED CELL DEATH. II. Predicted and Observed Cell Survival. Carrano, A. V. (Univ. of California, San Francisco). Mutat. Res.; 17: No. 3, 355-366(Mar 1973).

The surviving fraction of synchronous V79 Chinese hamster cells was measured in two post-irradiation generations after a 300-rad x-ray dose in G_1 by comparing the colony multiplicity in irradiated and control cultures. In addition, the ability of the irradiated population to form colonies was measured immediately after G_1 irradiation or at 6, 32, 75, or 96 h after x irradiation. Formulae were used in conjunction with previously observed transmission and survival parameters of chromosome aberrations to predict the amount of cell death at any given time after irradiation. The results indicate that the survival pattern of these cells can indeed be predicted on the basis of cell loss from chromosome aberrations. It is likely that an asymmetrical chromosome exchange (dicentric, centric ring, or tricentric) and a chromosome deletion are equally capable of causing cell death, whereas translocations or inversions apparently do not lead to inviability. Furthermore, cell death is rapid: 45% of the total observed death occurs in the first two post-irradiation generations. The initial decrease in viability is caused predominantly by the formation of anaphase bridges, while cell death from fragment loss becomes increasingly important in later generations. In fact, it is probable that, on the average, a cell that loses a single acentric fragment will survive one generation. (auth)

8355 CHROMOSOME ABERRATIONS AND RADIATION-INDUCED CELL DEATH. I. Transmission and Survival Parameters of Aberrations. Carrano, A. V. (Univ. of California, San Francisco). Mutat. Res.; 17: No. 3, 341-353(Mar 1973).

Synchronous cultures of V79 Chinese hamster cells were irradiated in G_1 with 300 rad of x rays. Cells were collected for 2-h intervals after synchronization to include the first three post-irradiation divisions and were scored for chromosome aberrations. After the first post-irradiation division, asymmetrical exchanges were distributed according to the Poisson formula and both the asymmetrical exchange frequency and the acentric fragment frequency exhibited significant variations with collection time. Formulae derived from a previous mathematical analysis were used in conjunction with the aberration frequencies observed at the first, second, and third post-irradiation divisions to predict transmission and survival parameters for specific chromosomal aberrations. The probability, 2T, that an acentric fragment will be transmitted to a daughter cell at anaphase was found to be 0.57. The probability, W, that a two-break aberration (asymmetrical exchange) will be transmitted and observed at the next division was 0.56. Finally, the probability, P, that a cell will survive to a subsequent mitosis after losing a single acentric fragment was about 1.0 for one post-irradiation generation but somewhat less for two generations. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 8374 and 8375.

8356 (SLA-73-161) THERMORADIATION INACTIVATION OF NATURALLY OCCURRING ORGANISMS IN SOIL. Reynolds, M. C.; Lindell, K. F.; David, T. J. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 10p. Dep. NTIS $3.00.

The effectiveness of dry heat and ^{60}Co γ radiation, delivered at dose rates ranging from 1×10^6 rad/hr to 4×10^3 rad/hr, was compared for the sterilization of microorganisms occurring naturally in soil. The effectiveness of the combination of dry heat and γ radiation for inactivation of spores of Bacillus subtilis was also studied. The soil organisms were frequently either heat resistant or radiation resistant, but the spores were found to be resistant to both. Preliminary studies on the response of naturally occurring spores of soil organisms to synergistic treatment for all temperatures and dose rates of interest are reported in progress. (CH)

8357 MICROBIOLOGICAL SAFETY OF IRRADIATED FOODS. Behavior of Clostridium botulinum type E in Irradiated Fish. Experiments Carried Out. De la Sierra Serrano, D.; del Real Gomez, G.; Perez Florez., J. Energ. Nucl. (Madrid); 17: No. 81, 21-34(1973). (In Spanish).

After a few brief considerations on the possibilities of the irradiation of foods, the international specifications on microbiological safety for the consumer of irradiated fish, and the incidence of Clostridium botulinum in fish products there is a presentation of the experimental results obtained in tests on the radioresistance of Clostridium botulinum, the radiosensitivity of Clostridium botulinum, influence of radiosensitive additives, indirect radiosensitivity, etc., pointing out also in detail the material and methods of the work. (tr-auth)

8358 RADIATSIONNAIA GENETIKA MIKROORGANIZMOV. (Radiation genetics of microorganisms). Zakharov, I. A.; Kriviskii, A. S. Moscow; Atomizdat (1972). 297p.

The radiation genetics of microorganisms is discussed for the first time in a systematized form as a separate discipline of genetics and radiobiology. Data concerning the lethal and mutagenic action of various types of radiation on fungi, microscopic algae, bacteria, and viruses are presented and generalized. Particular attention is paid to methods of biophysical analysis of the results of radiation-genetics experiments, to the dependences of radiation effects on dose, to the problem of genetic monitoring of

radiostability and the restoration of micro-organisms suffering from lethal and premutational injuries. The molecular bases of the lethal and mutagenic action of radiation are considered. The development of the radiation genetics of microorganisms in the USSR is reviewed, noting the important contributions of Soviet scientists to this field. (IAA) (International Aerospace Abstr.)

8359 MICROBIOLOGICAL OBSERVATION ON THE γ IRRADIATION PRESERVATION OF TOMATOES. Magaudda, G.; Inghilesi, E. (CNEN, Rome). Agrochimica; No. 8, 569-574 (1971). (In Italian). (RT/BIO-(72)38).

A different radiosensitivity between bacterial and fungal populations was observed in microbiological studies dealing with food irradiation carried out on some varieties of tomato. The most numerous species isolated were: Cladosporium, Alternaria, Stenphyllium, Fusarium, Penicillium, and Botrytis. The development of the bacterial species, Botrytis, and Penicillium was sufficiently controlled with gamma radiation doses up to 300 krads. The behavior of the microbial population during storage and the presence of different kinds of rot according to the irradiation dose, to anticryptogamic treatments and to storage conditions were also described. (auth)

8360 INTERNATIONAL PROJECT IN THE FIELD OF FOOD IRRADIATION, KARLSRUHE, FEDERAL REPUBLIC OF GERMANY. First Activity Report 1971. Karlsruhe, Ger.; Institut fuer Strahlentechnologie (1972). 28p.

The International Project in the Field of Food Irradiation came into being on October 14, 1970 by the signing of the International Agreement by organizations representing 19 countries. The new Project is being sponsored and supported by various health authorities as well as other research organizations and industrial undertakings. Host center facilities for the Project are provided by the German authorities at the Institute for Radiation Technology, Federal Research Institute for Food Preservation, Karlsruhe. The tasks to be undertaken by the Project are as follows: (1) wholesomeness testing of irradiated food. (2) Investigations into the methodology of wholesomeness testing. (3) Dissemination of information concerning wholesomeness testing. (4) Assisting national and international authorities in their consideration of the acceptance of irradiated food. The first priority in the program of the Project has been to start investigations on the wholesomeness of irradiated potatoes, wheat, wheat flour, and other products. Further work will include the investigation of irradiated fish, rice, poultry, egg products, shrimps, and mangoes. (GE)

8361 CONTROL AND IDENTIFICATION OF FOODS IRRADIATED FOR PRESERVATION PURPOSES. State of the Question in 1972. Morre, J. Rayonnements Ionis. Tech. Mes. Prot.; No. 1, 49-58(Jan 1973). (In French).

Legislations for the utilization of small doses of radiation are currently being examined in various countries. However, existing legislation acceptable in one country is not necessarily acceptable in another country. In consequence, several physical, histological, and chemical methods have been developed to identify irradiated products crossing the frontiers between different countries: measurement of the paramagnetic state of the nucleus (ESR); measurement of the conductivity of potato parenchyma; differential thermal analysis; spectrophotometry and spectropolarimetry; histological studies of the potato; thin film and gas phase chromatography; concentration of muscle proteins on thin films at position depending on their isoelectric points; establishment of the existence of deoxysugars in irradiated wheat, flour, and potatoes; electrophoresis on starch gel; examination of weight losses occurring during the preservation of irradiated fruits; and radiopasteurization of frozen eggs. (France)

8362 EFFECT OF LOW-ENERGY ELECTRON BOMBARDMENT ON BACTERIAL SPORE CATALASE. Lefebvre, G. M. (Univ. of Quebec). Radiat. Res.; 54: No. 2, 234-238(May 1973).

Using range-restricted electrons as probes it was possible to show that the catalase of Bacillus megaterium 14581 (ATCC) spores lies just inside a permeability barrier approximately 275 Å thick, the outer limit of which is about 350 Å from the spore's surface. The catalase itself appears to be separated into two fractions by a second barrier to permeability at about 1000 Å from the cell's surface. (auth)

8363 SENSITIVITY OF MEIOTIC YEAST CELLS TO ULTRAVIOLET LIGHT. Simchen, G.; Salts, Y.; Pinon, R. (Univ. of Washington, Seattle). Genetics; 73: No. 4, 531-541(Apr 1973).

Sporulating cells of Saccharomyces cerevisiae show an increasing sensitivity to uv irradiation. Maximum sensitivity is reached at a time comparable to meiotic prophase. Sensitivity is expressed as reduced sporulation after the irradiation. The uv effect can be efficiently reversed by photoreactivating light. Viability is also more severely affected during premeiotic DNA synthesis and during meiosis than in earlier stages in sporulation. Cells left in sporulation medium after the irradiation show a reduced viability compared with the cells plated immediately after the irradiation. Non-sporulating diploids do not acquire sensitivity when exposed to sporulation medium, hence the sensitivity is related to the sporulation process. That meiosis itself is affected, rather than spore formation alone, is evident from experiments in which the uv irradiation interferes with the uncovering of a recessive marker and with commitment to meiosis. It is proposed that during meiotic prophase, the DNA repair system is different from that found in vegetative cells. (auth)

8364 POSTEFFECT OF OXYGEN IN IRRADIATED BACTERIA: A SUBMILLISECOND FAST MIXING STUDY. Michael, B. D.; Adams, G. E.; Hewitt, H. B.; Jones, W. B. G.; Watts, M. E. (Mount Vernon Hospital, Northwood, Eng.). Radiat. Res.; 54: No. 2, 239-251(May 1973).

An ultrafast mixing technique was developed to investigate the kinetics of rapid radiobiological processes. The technique was applied to the study of the time scale of the oxygen effect in irradiated Serratia marcescens. The bacteria were held on a Millipore filter inside a chamber which was usually flushed with humidified nitrogen and were exposed to an explosion of oxygen released into the chamber through a fast-acting solenoid-operated valve. The bacteria were irradiated with a single 2-μsec pulse of 1.8-MeV electrons from a linear accelerator. The arrival of oxygen at the bacteria was timed to occur at a preset interval before or after the electron pulse. The time resolution was 100 μsec. After fixed doses of 10, 19, and 28 krads per pulse, the bacterial survival was measured as a function of the oxygen contact time. It was found that, when oxygen contact occurred at any instant before or up to the time of the electron pulse, full sensitization was obtained. However, bacteria exposed to oxygen at times after the electron pulse showed decreasing sensitization as the time interval increased, the survival approaching the anoxic control value at times greater than 2 msec. The data show that, in Serratia marcescens irradiated under anoxic conditions, oxygen-dependent damage decays approximately exponentially with a half-life of about 500 μsec. (auth)

8365 OXYGEN DIFFUSION TIMES IN BACTERIAL CELLS IRRADIATED WITH HIGH-INTENSITY PULSED ELECTRONS: NEW UPPER LIMIT TO THE LIFETIME OF OXYGEN-SENSITIVE SPECIES SUSPECTED TO BE INDUCED AT CRITICAL SITES IN BACTERIAL CELLS. Epp, E. R.; Weiss, H.; Kessaris, N. D.; Santomasso, A.; Helsin, J.; Ling, C. C. (Sloan Kettering Inst. for Cancer Research, New York). Radiat. Res.; 54: No. 2, 171-180 (May 1973).

A new upper limit of 1×10^{-4} seconds was measured for the lifetime of oxygen-dependent chemical species suspected to be induced at critical sites in irradiated bacterial cells. The technique employed involved the delivery of two high-intensity electron pulses to a thin wet layer of bacterial cells surrounded by a known concentration of gaseous oxygen. The pulses were of 3 nsec duration provided by two 600-kV electron sources utilizing the phenomenon of field emission. The first pulse was designed to provide sufficient dose to deplete oxygen completely from within the bacteria by radioinduced chemical reactions. The second pulse was applied to the cells at an accurately known time interval, which was variable throughout the microsecond and millisecond regions. The amount of oxygen rediffused to critical sites within cells during the interpulse time was inferred from the known response of cells to single short-pulse irradiations. In this way the diffusion of oxygen in the irradiated cells was measured over six decades in time for various initial oxygen concentrations and pulsed dose values. The shortest interpulse time during which a significant concentration of oxygen was restored in the cells as measured by a change in cellular radiosensitivity yielded the new upper limit to the lifetime of the suspected oxygen-sensitive species. (auth)

8366 REPARATION AND MUTAGENESIS. III. Effect of Mutations to Radiosensitivity on uv-Induced Forward Mutations and Reversions in ade-2 Locus in Saccharomyces Cerevisiae. Koval't-sova, S. V. (Leningrad Inst. of Nuclear Physics). Genetika; 9: No. 3, 110-115(Mar 1973). (In Russian).

The mutation to uv- and x-ray sensitivity xrs_1 increased the frequency of uv-induced mutations requiring adenine; mutations xrs_2 and xrs_4 did not affect mutations of this type. At the same time mutations xrs_2 and xrs_4 decreased the number of uv-induced reversions of <<ochre>>-suppressible allele ade-2-226, and the mutation to uv-sensitivity uvs_1 increased the frequency of reversions at equal doses as compared with the wild type. Tests of complementation of uv-induced mutations in locus ade-2 in the radiosensitive strains detected a difference between the wild-type and mutants xrs_2 and xrs_4, which were found to have more non-complementing mutations than the wild type. The mutations uvs_1 and xrs_1 did not affect qualitative structure of ade-2 mutations. (auth)

8367 REPAIR MECHANISMS INVOLVED IN PROPHAGE REACTIVATION AND UV REACTIVATION OF UV-IRRADIATED PHAGE λ. Blanco, M.; Devoret, R. (CNRS, Gif-sur-Yvette, France). Mutat. Res.; 17: No. 3, 293-305(Mar 1973).

Survival of uv-irradiated phage λ is increased when the host is lysogenic for homologous heteroimmune prophage such as λimm434 (prophage reactivation). Survival can also be increased by uv-irradiating slightly the non-lysogenic host (uv reactivation). Experiments on prophage reactivation were aimed at evaluating, in this recombination process, the respective roles of phage and bacterial genes as well as that of the extent of homology between phage and prophage. To test whether uv reactivation was dependent upon recombination between the uv-damaged phage and cellular DNAs, lysogenic host cells were employed. Such hosts had thus as much DNA homologous to the infecting phage as can be attained. Therefore, if recombination between phage and host DNAs was involved in this repair process, it could clearly be evidenced. By using unexposed or uv-exposed host cells of the same type, prophage reactivation and uv reactivation could be compared in the same genetic background. The following results were obtained: prophage reactivation is strongly decreased in a host carrying recA mutations but quite unaffected by mutation lex-I known to prevent uv reactivation; in the absence of the $recA^+$ function, the red^+ but not the int^+ function can substitute for $recA^+$ to produce prophage reactivation, although less efficiently; prophage reactivation is dependent upon the number of prophages in the cell and upon their degree of homology to the infecting phage. The presence in a recA host of two prophages either in cis (on the chromosome) or in trans (on the chromosome and on an episome) increases the efficiency of prophage reactivation; upon prophage reactivation there is a high rate of recombination between phage and prophage but no phage mutagenesis; and the rate of recombination between phage and prophage decreases if the host has been uv-irradiated whereas the overall efficiency of repair is increased. Under these conditions uv reactivation of the phage occurs as in a non-lysogen, as attested by the high rate of mutagenesis of the restored phage. These results demonstrate that uv reactivation is certainly not dependent upon recombination between two preexisting DNA duplexes. The hypothesis is offered that uv reactivation involves a repair mechanism different from excision and recombination repair processes. (auth)

8368 RADIOSENSITIVITY AND PHENOLIC AND QUINONIC RADIOSENSITIZING AGENTS. Ramos Avila, E. L. (Instituto de Farmacologia y de Quimica-Fisica, Madrid). Arch. Inst. Farmacol. Exp. (Madrid); 21: No. 1-2, 69-100(1969). (In Spanish).

Three diphenols of benzene, 1,3-dihydroxynaphthalene, p-quinone, and 1,2-naphthoquinone-4-sulfonic acid Na salt, were applied to cultures of haploid Saccharomyces cerevisiae. The toxicity of the products in the yeast cultures was determined by applying different doses (0 to 250 μg). The toxicity of radiation was determined by applying 10 doses to the cultures (0 to 120 krad). The LD_{50} was determined in both cases. The combined effect of the two agents, product and radiation, was then determined. Using the experimental values found for each combination, the potentiation factor (p.f.) of each product was calculated. The p.f. values calculated were: pyrocatecol 1.69; resorcinol 1.57; hydroquinone 1.49; p-quinone 1.57; 1,3-dihydroxynaphthalene 1.59; and 1,2-naphthoquinone-4-sulfonic acid Na salt 1.55. (ERB)

8369 RADIOSTERILIZATION OF MEDICAL PRODUCTS. 13. Microbial Contamination on Silk Sutures Prior to Sterilization. Sato, K.; Takuma, F. (Tokyo Metropolitan Isotope Research Center). Ikakikaigaku Zasshi; 42: No. 11, 697-702(Nov 1972). (In Japanese).

In order to investigate the degree of contamination with microbacteria in commercially available silk sutures, 2.5×10^6 R of ^{60}Co gamma ray was applied for radiosterilization of hard and soft silk sutures. Bacteria spore suspension (0.1 ml) was dropped on the sterilized materials that were kept as samples in freeze-drying. For cleaning and washing out the bacteria in the silk sutures, the shaking and homogenizing methods were applied in the solution of 0.1% of Tween, 1% of Peptone, and 0.8% of NaCl. It was found that changes in bacteria number are little influenced on the condition of shaking for 30 min or homogenizing for 2 min in the process of cleaning and washing. The number of general microbacteria detected in the hard silk sutures in the process of cleaning was 2.7×10^3 to 6×10^5/g. The number of the general microbacteria detected in the raw silk materials was 2.7×10^4 to 2.9×10^5/g. It was also found in this study that 10^4 to 10^5/g of microbacteria was in almost all raw materials before any kind of processing. It was proved, therefore, that the microbacteria found in the hard suture had already existed in the raw silk materials. (Japan)

8370 MUTATION BY MITOMYCINS IN THE ULTRAVIOLET LIGHT SENSITIVE MUTANT OF ESCHERICHIA COLI. Murayama, I.; Otsuji, N. (Kyuhu Univ., Fukuoka). Mutat. Res.; 18: No. 1, 117-119(Apr 1973).

Evidence is presented that monofunctional mitomycins induced mutation in uv-radiosensitive (uvr^-) strains of Escherichia coli with much higher frequency than that in wild-type bacteria, while mitomycin C did not induce mutation in these uvr^- strains. (ERB)

8371 EFFECTS OF THE recA, lex, AND exrA MUTATIONS ON THE SURVIVAL OF DAMAGED λ AND Π PHAGES IN LYSOGENIC AND NON-LYSOGENIC STRAINS OF ESCHERICHIA COLI K12. Kerr, T. L.; Hart, M. G. R. (Queen's Univ., Belfast). Mutat. Res.; 18: No. 1, 113-116(Apr 1973).

Major differences were demonstrated between the effects of different genetic backgrounds on the uv reactivation and prophage reactivation in Escherichia coli K12. It was also found that the E. coli phage PI, which has only rare homology with the E. coli chromosome, is uv reactivated as extensively as phage 2. In contrast, prophage reactivation of uv damaged PI vir-s phage was not obtained in PI lysogens. It was concluded that uv reactivation and prophage reactivation occur by different mechanisms. (ERB)

Radiation Effects on Plants

8372 CORRELATION OF ESR AND RADIOBIOLOGICAL OBSERVATIONS OF THE TEMPERATURE AND OXYGEN EFFECTS IN OSMUNDA REGALIS SPORES AFTER IRRADIATION WITH FAST ELECTRONS. Dodd, N. J. F.; Ebert, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Radiat. Bot.; 13: No. 2, 87-96(Apr 1973).

Dried spores of Osmunda regalis were irradiated in N_2 with 10-MeV electrons and the influence of temperature and O_2 on the radiation-produced free radicals was studied by ESR. Irradiation produced several different radical groups. The concentration of one of these groups, characterized by a broad ESR signal of line width 25G, could be reduced by 30 to 40% by heating in N_2. The apparent activation energy of this process was 20.5 ± 2.1 kcal $mole^{-1}$. Introduction of O_2 to the irradiated spores resulted in complete decay of this radical group and formation of a new radical group characterized by a narrow signal of line width 9G. The apparent activation energy for formation of this new radical group was 13.1 ± 0.7 kcal $mole^{-1}$. Although the extent of formation of these radicals was reduced by prior annealment, the rate and apparent activation energy were unaffected. Decay of the broad signal in O_2 and appearance of the narrow signal involved two distinct stages since the rate of decay of the broad signal was significantly faster than the rate of formation of the narrow signal, although both processes had similar activation energies. From these findings a strong quantitative correlation can be made between the radicals giving the broad signal and the precursors of radiobiological oxygen damage and between the radicals giving the narrow signal and the species responsible for post-irradiation oxygen damage. (auth)

8373 RADIATION-INDUCED STIMULATION OF POLLEN-TUBE ELONGATION IN DOUGLAS-FIR. Livingston, G. K.; Stettler, R. F. (Univ. of Washington, Seattle). Radiat. Bot.; 13: No. 2, 65-72(Apr 1973).

Mature pollen of Douglas-fir (Pseudotsuga menziesii) was subjected to gamma radiation from a ^{60}Co source at exposures of 4, 8, 16, 32, 64, 128, and 256 kR and incubated on an agar medium in vitro. Whereas germination % remained constant regardless of treatment, pollen-tube lengths at 48 hr of incubation were positively correlated with radiation dose. The same results were found with x rays. Irradiation seemed to both speed up germination and increase the rate of elongation. Oxygen uptake, as measured by a respirometer, increased proportionately to dose up to 64 kR, but declined at higher doses. At the microscopic level, the two highest doses caused an exfoliation of the outer layers of the intine at the time of germination. It is suggested that the observed stimulation of pollen-tube elongation is brought about by an enhanced metabolism at the lower doses; but by a physical change in cell-wall properties at the higher doses. (auth)

8374 GLUCIDE METABOLISM AND VITAMIN C AND PP CONTENT IN IRRADIATED AND CHEMICALLY TREATED POTATOES. Baraldi, D. (CSN, Rome); Guerrieri, G.; Miuccio, C. F. Agrochimica; No. 8, 538-545(1971). (In Italian). (RT/BIO-(72)35)

Potatoes of the Bintje variety were irradiated with ^{60}Co at 10 krad: contemporarily, potatoes of the same variety were treated using 10 ppM of a chemical antisprouting substance (IPC: CIPC). The samples were stored at the temperature of 10°C and 85 to 90% of relative humidity. The glucide metabolism was checked by measuring the variations in the content of total and reducing sugars and sucrose during a 10 month storage. The irradiation process was found to affect the amount of reducing sugars, particularly during the first months of storage: they were greatly increased, as compared with the chemically treated samples and the controls. Irradiated potatoes did not present any change in the

content of total sugar and sucrose. No significant variation was found in the vitamin C and PP levels. (auth)

8375 EFFECT OF GAMMA IRRADIATION ON CAROTENOID SYNTHESIS AND COLOR DEVELOPMENT IN TOMATOES. Baraldi, D. (CNEN, Rome). Agrochimica; No. 8, 556-562(1971). (RT/BIO-(72)36).

Tomatoes (cultivar Supermarmande) irradiated at two different stages of maturity, with doses of 150 and 250 krad, and then stored at room temperature, show a marked decrease in color development. The biosynthesis of lycopene and β-carotene is delayed to a great extent in the irradiated sample for more than 10 days. Chlorophyll and phaeophytin are present in a higher amount in the irradiated tomatoes: they disappear within 10 days in the control sample while they are still present in the irradiated sample. Lutein seems not to be affected by the given doses. The delay of ripening in tomatoes is greater when irradiation is made at the green stage of maturity. (auth)

8376 GROWTH INHIBITORS IN A RADIATION INDUCED DWARF BEAN MUTANT. Morales, C. (Escuela Nacional de Agricultura y Ganaderia, Managua); Greene, G. L. Contract AT(30-1)-2043. 22: No. 2, 168-172(1972). (COO-3217-200).

The neutral ethyl acetate fractions of normal and Dwarf-1 mutant Phaseolus vulgaris L. seeds were analyzed by thin-layer chromatography and found to be identical in gibberellin content. Bioassays with these fractions using a dwarf bean leaf disc test revealed that the gibberellins isolated from either line were equally capable of reversing dwarfism. The Dwarf-1 fraction contained in addition a substance which was specifically inhibitory to the neutral fraction gibberellins. The mutation to this type of dwarfism apparently unbalances the mechanism by which the normal plant controls growth, and results in an excessive attenuation of the gibberellin hormones. (auth)

8377 ONTOGENY OF FUNDAMENTAL PLANT TISSUES STUDIED BY PERICLINAL CYTOCHIMERAS. Donini, B. (CSN, Rome). G. Bot. Ital.; 105: No. 4, 184-185(1971). (RT/BIO-(72)30).

Dormant peach bud cytochimeras were exposed to ^{60}Co γ radiation at doses of 400, 600, 800, 1200, or 1600 R. The results obtained show that radiation affected the stability of the chimeras and even at the lowest dose of 400 R 80% of the observed apices of the 4n-2n and 2n-4n type respectively had changed from the initial stratification. The stability of the cytochimeras decreased with increasing dose and at 1600 R 80% of the apices of the 4n-2n chimeras showed the presence of diploid and tetraploid cells in the same layer. The following conclusions were drawn concerning the irradiated chimeras: cells may shift from one layer to another; there is the chance of cell shifting from the outer to the inner layers and vise versa; and possible differences exist for the stability between the two types of cytochimeras. (ERB)

8378 TOTAL PROTEIN TO DNA RATIO IN 2C NUCLEI OF DRY SEED MERISTEMS IN RELATION TO CHROMOSOME AND CHROMATID ABERRATIONS INDUCED BY X IRRADIATION. Ancora, G. (CNEN, Rome); Brunori, A.; Martini, G. Cardiologia; 25: No. 3, 373-381(1972). (RT/BIO-(72)79).

Total nuclear protein content was determined in G_1 cells (2C DNA content) of embryonic meristems in dry seeds in two groups of species: (i) those having meristems composed exclusively of G_1 cells, which react to x-rays with chromosome (B'') aberrations (Allium cepa, Helianthus annuus, Pinus pinea) and (ii) those having meristems composed of both 2C (G_1) and 4C (G_2) cells in different proportions and in which part of G_1 cells react to x rays with chromatid (B') aberrations (Vicia faba, Triticum durum, Triticum dicoccum, and Aegilops longissima). In species of (i), nuclear protein content in G_1 cells was rather constant, while in species of group (ii) a great variability of total nuclear protein content in G_1 cells was detected. The hypothesis is advanced that the protein moiety of chromosomes rather than changes in the DNA molecule may be responsible for the transition from chromosome to chromatid aberration in irradiated G_1 cells. (auth)

8379 STUDY OF PROTECTION OF LIVING ORGANISMS FOLLOWING IONIZING RADIATION. Cerkovnikov, E.; Kirigin, M.; Steiner, A. Acta Fac. Med. Fluminensis; 5: 25-33(1970). (In Slovene).

The aim was to show simultaneously the results of experiments on all generations: R1, R2, R3, Ro3, and R4 on Szürkebarát soy beans. The protection of soy beans by plant hormones after the x radiation was examined. (auth)

8380 EFFECT OF AMINO ACIDS ON GAMMA-IRRADIATED WHEAT SEEDS. Mathur, J. R.; Bhandari, M. M.; Bhandari, K. (Udaipur Univ., Tobner, India). Indian J. Hered.; 2: No. 1, 69-72(1970).

An apparent reversal of the injurious effects of 30 kr gamma irradiation on germination of wheat seedlings and of induced chromosome aberrations was noticed by post-treatment for 4 hr with an amino acid supplement of 0.05 M asparagine and 0.005 M soln. of serine. In irradiated seeds untreated with amino acids, 68.5% of metaphase and anaphase cells were aberrant. Only 12.5% reduction was observed in 0.005 M asparagine. Reductions of 20.5, 26.6, and 27.7% were observed in 0.05 asparagine, 0.005 serine, and 0.05 molar serine, respectively. (Indian Sci. Abstr.)

8381 RESOLVING THE ENIGMA OF MULTIPLE MUTANT SECTORS IN STAMEN HAIRS OF TRADESCANTIA. Mericle, L. W.; Mericle, R. P. (Michigan State Univ., East Lansing). Genetics; 73: No. 4, 575-582(Apr 1973).

Mutant sectors in stamen hairs of Clone 02 Tradescantia are designated as multiple sectors when two or more occupy the same hair, separated by nonmutant cells. Statistical analyses show that most multiple sectors do not arise as chance associations of independent events: when the frequency of stamens with two or more sectors is lowest, the probability that the sectors will be located in the same, rather than in different, hairs is highest. Ontogenetically, the ratio of sector pairs in different hairs to pairs in the same hair is highest in that period of response to acute irradiation prior to the appearance of entire-hair sectors; thereafter, the ratio subsides, approaching that of spontaneous mutation and indicating that the initiating event takes place early in hair development. Most mononemic chromosome models will not account for the production of multiple mutant and non-mutant sectors, dispersed along a linear structure such as a stamen hair, following a single mutational event. Consideration is given to two models (one mononemic, and the other dinemic) that will readily provide the possibilities for either the immediate segregation of mutant and non-mutant cells, or for the perpetuation in daughter nuclei of a heterozygous chromosome capable of segregation at some later mitosis. The dinemic model is preferred because it affords operation of the mutation mechanism (including breakage and deletion) at either the DNA molecule or subunit level. (auth)

8382 GENETIC REGULATION OF CHROMOSOME PAIRING IN DELPHINIUM. Chauhan, K. P. S.; Jain, H. K. (Indian Agricultural Research Inst., New Delhi). Indian J. Genet. Plant Breed.; 32: No. 1, 156-164(Mar 1972).

The internuclear distribution of univalents was analysed in several partially asynaptic plants obtained from irradiated and inbred populations of Delphinium. It was observed that in all the three inbred plants the distribution pattern deviated significantly from a normal or poisson type of distribution. One of these plants was found to show preponderance of two extreme classes of cells—one showing complete bivalent formation, the other showing all the chromosomes as univalents. This indicates that the control of chromosome pairing and chiasma formation in a cell is based to some extent on qualitative rather than purely quantitative type of genetic determination. In contrast to the inbred plants, several of the plants from the irradiated population showed a distribution of univalents that corresponds with the poisson type. On the basis of all the observations it was concluded that the genetic control of chromosome pairing and chiasma formation involves major genes and some modifiers. (auth)

8383 EFFECTS OF INDUCED STERILITY AND DISTANCE ON THE INCIDENCE OF OUT-POLLINATION IN RICE. Joshua, D. C.; Rao, N. S. (Bhabha Atomic Research Centre, Bombay). Indian J. Genet. Plant Breed.; 32: No. 1, 55-59(Mar 1972).

The effects of gamma ray dose, induced sterility, and the distance between pollen donor and recipient lines on the incidence of cross-fertilization were studied in two varieties belonging to the two subspecies, viz., japonica and indica of Oryza sativa. While higher doses of gamma rays and increased sterility of M_1 panicles led to an increase in the incidence of cross-fertilization, increasing distances between pollen donor and recipient lines reduced the frequency of hybrid seedlings. Differences between the two varieties in their response to foreign pollen was also observed. (auth)

8384 FLORAL MORPHOLOGY OF A RADIATION-INDUCED MUTANT OF JUTE. Abraham, V.; Joshua, D. C. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Genet. Plant Breed.; 32: No. 1, 50-54(Mar 1972).

A dwarf, sterile mutant obtained from Corchorus olitorius Linn. var. JRO 632, following irradiation of seeds with ionizing radiation was characterized by contorted leaves and the absence of normal ovary. The number of sepals and petals varied from 3 to 6, stamens were more numerous, varying from 35 to 95 in the mutant against 34 to 45 in the control. The carpels which are normally six and syncarpous were modified into lateral leafy structures giving the appearance of a shoot apex. Practically, this mutant behaved as a male plant. (auth)

8385 NEW PRECOCIOUS MUTANT OF ARABIDOPSIS THALIANA. Arshanskaya, M. Sh.; Savin, V. N. (Research Inst. of

Agrophysics, Leningrad). Genetika; 9: No. 3, 163-165(Mar 1973). (In Russian).

A new precocious mutation in Arabidopsis thaliana was isolated in the second generation after irradiation with gamma-rays. The duration of the period preceding the efflorescence in the mutant grown in the soil and on an agar medium is 71.1% and 81.0% respectively of that in the wild type. The mutants are fertile; therefore this mutation can be recommended for various genetic investigations. (auth)

8386 BIOLOGICAL AND BIOCHEMICAL EFFECTS OF γ RAYS ON THE MARINE ALGA ACETABULARIA MEDITERRANEA. Kirchmann, R. J.; Bonotto, S. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 527-541 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973). (In French)

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

The marine alga Acetabularia mediterranea Lamouroux is a unicellular organism that may reach several centimetres in length. This giant cell, which can be easily enucleated, is very convenient for the study of radiation effects in the presence and in the absence of the nucleus. The effects of ^{60}Co γ radiations on the growth and on the morphological differentiation of the alga and on its nucleic acid and protein synthesis were studied. It was found that: The radiations inhibit cap formation in whole as well as in anucleate cells: a dose of 125 krad is necessary to obtain a complete inhibition of this morphogenetic process; irradiated cells show several types of morphological anomalies; growth of an adult or of an initiated cap (±2 mm) is reduced only at very high radiation doses; when whole algae are irradiated at stage 5, a reversion from the reproductive to the vegetative growth is often observed, the radiations inhibit nucleic acid more strongly than protein synthesis; the synthesis of new ribosomes in inhibited by the radiations. These biological and biochemical observations show that the irradiated cell is incapable of differentiating though it continues to perform protein synthesis at an appreciable rate. The radioinduced morphological anomalies seem to suggest that the radiations could inhibit the cellular differentiation by altering the ultrastructure of the apical region of the stalk. (auth)

8387 STRUCTURE OF CHROMATID ENDS AND THE ENDS OF EXPERIMENTALLY PRODUCED CHROMATID FRAGMENTS AS REVEALED BY TRYPSIN TREATMENT OF VICIA FABA CHROMOSOMES. Traut, H.; Scheid, W. (Univ., Muenster, Ger.). Mutat. Res.; 17: No. 3, 335-340(Mar 1973).

After digestion with trypsin, the metaphase chromatids of Vicia faba reveal two length structures (half-chromatids). This confirms the results of other authors. According to our observations the half-chromatids are connected at their ends in such a way that a U-shaped configuration is formed. This finding can be explained in different ways. The ends of chromatid fragments obtained after x irradiation are either U-shaped (closed) like the natural chromatid ends or open, i.e., the two half-chromatids do not seem to be connected at their ends. As a by-product of our experiments, the structure of x-ray-induced achromatic lesions (gaps) was studied in trypsin-treated chromosomes. (auth)

8388 COMPARATIVE LENGTH MEASUREMENTS OF VICIA FABA CHROMATIDS WITH X-RAY-INDUCED ACHROMATIC LESIONS (GAPS). Scheid, W.; Traut, H. (Univ., Muenster, Ger.). Mutat. Res.; 18: No. 1, 25-31(Apr 1973).

In order to answer the question whether with the x-ray induction of an achromatic lesion (a gap) an increase of the chromatid length is involved (e.g., by a localized failure of spiralization), the length ratios of 26 straight and 22 flexed metaphase chromosomes of Vicia faba were measured. (The length ratio is defined as the quotient between the length of the chromatid with a gap and that of its sister-chromatid without a gap). Our results agree with the hypothesis that the induction of a gap does not increase the length of the chromatid. Remarkably in each of the 22 flexed chromosomes the gap was located at the outer chromatid. The bearing of our results on the nature of x-ray-induced achromatic lesions is discussed. (auth)

8389 POST-IRRADIATION RECOVERY OF PLANTS AND ITS MODIFICATION. Grodzinskii, D. M. (Inst. of Plant Physiology, Kiev). Fiziol. Biokhim. Kul't. Rast.; 3: No. 3, 314-323 (1971). (In Russian).

Basic results of a ten-year research program of the Department of Biophysics and Radiobiology of the Institute of Plant Physiology are considered. These results are discussed in relation to post-irradiation recovery of plants. Emphasis is placed on molecular mechanisms, biosynthetic methods of recovery, DNA synthesis, and cell proliferation. Effects of physical and chemical factors on these processes are discussed in relation to protection of plants against radiation damage. (HLW)

8390 EFFECT OF GAMMA RAYS ON CUT PROTEA COMPACTA BLOOMS. Haasbroek, F. J.; Rousseau, G. G. (Food and Fruit Tech. Research Inst., Stellenbosch, S. Afr.). Agroplantae; 3: 5-6(1971).

The effect of gamma rays on Protea blooms was investigated. Groups of 20 blooms each were selected at random and subjected to radiation dosages of 0, 10, 30, and 90 kr in a ^{60}Co-irradiation unit. The rate as well as the degree of opening of blooms was suppressed by irradiation. At a dose of 90 kr only four blooms opened slightly during the period of observation in contrast to the controls where 17 blooms opened at 10 kr. Even at 90 kr no ill effects were detectable with regard to the general appearance of the blooms. However, blackening of the foliage was aggravated by irradiation. (INIS)

8391 EFFECT OF TEMPERATURE ON STRUCTURAL CHROMOSOME MUTATIONS DURING POSTIRRADIATION GERMINATION OF CREPIS CAPILLARIS SEEDS. Nemtseva, L. S.; Yurgelaitite, K. N. V. (Inst. of General Genetics, Moscow). Genetika; 9: No. 3, 20-24(Mar 1973). (In Russian).

The temperature of germination of soaked gamma-irradiated Crepis capillaris seeds affected the frequency of chromosome aberrations. At lower temperatures the frequency was greater than at higher temperatures. In the course of a natural mutation process the frequency of aberrations slightly increased at low germination temperatures. (auth)

8392 EFFECT OF X RAYS ON THE REPRODUCTION AND DYNAMICS OF SOME COMPONENTS OF THE SUNFLOWER FRUIT DURING ITS DEVELOPMENT AND RIPENING. Cupic, Z.; Miric, M.; Damanski, A. (Farmaceutski Fakultet, Belgrade). Hrana Ishrana; 12: No. 9, 422-428(1971). (In Serbo Croatian).

The effect of x rays in doses of 10,000 and 20,000 R on the reproduction and dynamics of individual fruit components of the sunflower grown from irradiated seed during its development and ripening, was investigated. (Bull. Sci. Sect. A)

8393 FURTHER MULTIPLE FIXATION, CHROMOSOME ABERRATION, DOSE FRACTIONATION STUDIES ON VICIA FABA: THE EFFECT OF CYCLOHEXIMIDE. Miller, M. W.; Weiss, C. (Univ. of Rochester, New York). Mutat. Res.; 18: No. 2, 163-170 (May 1973).

Soaked seeds of Vicia faba were irradiated with 800 or 400 R, or two 400-R exposures, both with VAC (vacuum) but one with a concomitant treatment of CHM (cycloheximide (I μg/ml). The chromosome aberration yields from each regimen varied with fixation time such that a unique and characteristic aberration yield for each regimen relative to the others was not obtained. Were single fixations employed one could obtain yields that would indicate no, some, or maximum repair. A single fixation would lead to an incorrect estimation of chromosome damage repair. (auth)

8394 INFLUENCE OF PLANT HORMONES ON THE IN VITRO GROWTH OF WHEAT PREVIOUSLY X IRRADIATED. Steiner, A.; Mohorovicic, E.; Kirigin, M.; Cerkovnikov, E. (Faculty of Medicine, Rijeka, Yugoslavia). Acta Fac. Med. Fluminensis; 5: 7-17(1970). (In Slovene).

Plant hormones had considerable influence on the growth of irradiated and unirradiated grain. The effects were dependent on the concentration of the hormones. (auth)

8395 EFFECT OF PRE-SOWING GAMMA-IRRADIATED SEEDS IN RELATION TO THE GERMINATION BEHAVIOR OF INDIAN COLZA (BRASSICA CAMPESTRIS L. VAR. SARSON PRAIN). Garg, O. K.; Tiwari, B.; Singh, O. (Banaras Hindu Univ., India). Indian J. Agr. Sci.; 42: No. 7, 553-556(Jul 1972).

Selected seeds of mustard (Brassica campestris L.) were exposed to 10, 20, 30, 40, and 50 kR of gamma rays from a ^{60}Co source. These seeds were subsequently germinated under controlled laboratory conditions. Germination of mustard seeds was altered as a result of pre-sowing gamma irradiation of seeds. A low dose of 10 kR was found stimulatory whereas stronger doses (20 to 50 kR) were invariably inhibitory. Maximum linear growth and dry matter accumulation in roots and shoots were observed under lower doses of gamma irradiations. Stronger doses depressed the growth. Gamma irradiation also affected the physiological status of the germinating seedlings. The effect was on the same line, i.e., stimulatory at low doses and inhibitory at stronger doses. Pre-sowing gamma-irradiated seeds had a physiological bearing in controlling the germination behavior and growth of mustard plants. (auth)

Radiation Effects on Animals

Refer also to abstracts 8109, 8141, and 8230.

Man

Refer also to abstracts 7911, 8132, 8134, 8136, 8175, 8176, 8245, 8254, 8255, 8337–8339, 8496, 8532, 9959–9961, 9973, 9985, 9991, 9992, 10021–10023, and 10035..

8396 (CONF-700124-, pp 181-215) HEALTH ASPECTS OF ENVIRONMENTAL RADIOACTIVITY. Radford, E. P. (Johns Hopkins Univ., Baltimore). 1 Nov 1970.

From environmental radioactivity symposium; Baltimore, Maryland, USA (19 Jan 1970).

In environmental radioactivity symposium.

Data from experimental studies on animals and epidemiological studies on human populations are reviewed, from which it is concluded that ionizing radiations induce pathological changes in man that may lead to the induction of neoplasms. It is pointed out that data on the relative importance of the dose rate on the effects of low radiation doses is uncertain and the question of a threshold dose below which no effect may be induced is a highly debatable issue. The fragmentary evidence available to date on man suggest that some types of neoplasms may result with little or no threshold apparent for low radiation dose exposure. Difficulties in extrapolating data on genetic radiation effects from mice to man are discussed. It is concluded that, on the basis of the information available, the radiation exposure of large human populations to small increases in radiation doses from both external and internal sources should be minimized if possible. However, any increase in radioactivity in the environment due to operation of nuclear power plants will be small in comparison to the radioactivity due to natural background. (CH)

8397 (DHEW-73-8037) PROGRESS IN RADIATION PROTECTION. (Bureau of Radiological Health, Rockville, MD). 1972. 10p.

Progress in the USA in protecting consumers against radiation hazards during 1972 is reviewed. Key data on the nation's use of diagnostic x ray gave assurance that programs to reduce unnecessary x-ray exposure are succeeding. Communities throughout the country stopped the use of mass chest x rays to screen the general population for tuberculosis and other chest diseases. A Federal standard was promulgated requiring improved radiation control performance in diagnostic x-ray equipment and major components manufactured after August 15, 1973. The action will make x-ray examinations safer for millions of Americans. About 48,000 products were modified by manufacturers in Fiscal 1972 as a result of FDA efforts to reduce radiation exposure from color TV sets and other electronic equipment. (CH)

8398 (JAERI-M-5018) HEALTH PHYSICS AND SAFETY IN JAERI, NO. 14. (Japan Atomic Energy Research Inst., Tokyo). Dec 1972. 205p. (In Japanese). NTIS (U. S. Sales Only).

Activities of health physics and safety in the Tokyo Office of Safety and Control, Tokai Research Establishment, Takasaki Radiation Chemistry Research Establishment, and Oarai Research Establishment are described. This report corresponds to No. 2 of "Health Physics and Safety" that was titled "Activities in the Division of Health Physics and Safety" before 1970. (auth)

8399 (JPRS-59015) SPACE BIOLOGY AND MEDICINE, [Vol. 7], No. 2, 1973. Translation of Kosm. Biol. Med.; 7: No. 2, 3-90(1973). 145p. NTIS $9.25.

Separate abstracts were prepared for two papers. Nineteen additional papers discuss the selection and training of astronauts, data on the transition from orbital to interplanetary flight, the reliability of the human component of the man-spaceship system, environmental problems of space flight and their control, and physiological and psychological aspects of space flight. (CH)

For abstracts of individual papers see: 8336 and 8400.

8400 (JPRS-59015, pp 66-72) EFFECT OF RADIOPROTECTANTS ON FUNCTIONAL STATE OF THE VESTIBULAR ANALYZER. Suslova, L. N.; Efimov, V. I.; Kornilova, L. N.; Kumets, P. I.; Losev, A. A. 15 May 1973. Translated from Kosm. Biol. Med.; 7: No. 2, 45-48(1973).

The radioprotectants ambratine (cysteamine-hydrotartrate with pyridoxine), mexamine (5-methoxy-tryptamine) and vitamin-amino acid complex (amitetravite) in the tested doses produced no negative effect on the state of the vestibular analyzer and induced no decrease in vestibular stability of animals and humans. It is suggested that vestibular reactions be used in evaluating the effect of radioprotectants on the living organism. (auth)

8401 (KFK-1638, pp 43-49) RADIATION PROTECTION EXPERIENCE IN INTERVENTION IN THE KARLSRUHE REPROCESSING INSTALLATION. Herre, F. (Wiederaufarbeitung von Kernbrennstoffen mbH, Leopoldshafen, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The reprocessing installation became operational in May 1970. After four months improvement work, the plutonium section was tested with 1.2 kg Pu. Full operation started with the reprocessing of three tons of fuel elements in September 1971. During two years of full operation, more than 1500 interventions were required for repair work. These interventions furnished practical experience about respirators, protective clothing, monitoring equipment, skin contamination, and radiation burden to personnel. The maximal dose reached 1.8 rem in one individual. (HBG)

8402 (KFK-1638, pp 91-103) INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION (ICRP), PRESENT TRENDS AND NEW CONCEPTIONS. Jacobi, W. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The sphere of duties, the organization, and the functions of the ICRP are briefly described. In future, the definition of maximum permissible values of dose and dose equivalent, respectively, in the various organs has to be based on a clear risk concept. The application of such a risk concept requires: the establishment of the relation between dose and risk from single radiation-induced late-effects, including the time pattern of the risk in dependence of dose rate; the determination of the combined risk especially from whole-body irradiation; and the establishment of a maximum acceptable radiation risk. The problems and the trends that can be observed, due to the experience gained in the last years as to the risk of somatic late-effects are discussed. The resulting consequences with regard to a revision of the radiation protection standards are presented. Finally, a report is given on the new ICRP recommendations concerning the uptake of radioactive substances into the human body that will be passed in the near future. The considerations and calculations leading to the establishment of these activity limits are described. (GE)

8403 (KFK-1638, pp 117-126) EXPERIENCE IN RADIATION PROTECTION GAINED IN THE COURSE OF RADIOACTIVE WASTE TREATMENT AND DECONTAMINATION OF DEVICES AND FACILITIES. Koenig, L. A. (Kernforschungszentrum, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

Radiation protection and radiation monitoring has become one of the major tasks of the decontamination department within the framework of the health physics system of the Nuclear Research Centre Karlsruhe. As the increase in the activity throughout has brought about an increase in the personnel radiation exposure almost up to the permissible limit set up by the First Radiation Protection Ordinance, it has become necessary to determine the gamma and beta contribution of the radiation dose as exactly as possible. Hence those persons most exposed to radiation have been equipped with four dosemeters (film, glass, and thermoluminescent dosemeters as well as pocket ionization chambers). The measured values show quite a few deviations. The beta doses to be expected are estimated by means of measurements with soft-ray chambers or tissue-equivalent proportional counter tubes, as well as with pairs of glass and thermoluminescent dosemeters. In order to find appropriate methods to decrease the radiation exposure to the personnel, analyses have been made of the radiation exposure due to recurrent operations. In spite of the high activity throughput, only two major events are to be mentioned. One was the contamination of a room due to inundation with radioactive water, the other resulted in contamination of the sewage water system and the clarification plant subsequent to an inadvertent influx of radioactive water. (GE)

8404 (KFK-1638, pp 137-146) NEW STANDARDS AND STANDARDIZATION TRENDS IN DOSIMETRY AND RADIATION PROTECTION. Nachtigall, D. (Paedagogische Hochschule Ruhr, Dortmund, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

Standards are being prepared after the introduction of the SI-units, new developments in microdosimetry and extensive discussions on dose concept. A review is given of some trends towards standardization, especially in calibration techniques, special emphasis being given to neutron dosimetry. (GE)

8405 (KFK-1638, pp 169-176) AUTOMATION OF PERSONAL DOSIMETRY IN NUCLEAR POWER PLANTS. Schallopp, B. (Buero Schallopp, Berlin). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The use of a process computer permits the print-out of the dose status for each individual person. In this regard, long-term experience is available at Beznau where the process computer also performs statistical comparisons between various dosimeters. Instead of feeding the information into the computer by hand, a system is proposed that reads the dosimeters automatically and transmits the data directly to the computer. The proposal comprises programs for both the large process computers of nuclear power plants and the small computers applied exclusively to radiation protection. (HBG)

8406 (KFK-1638, pp 177-181) ELECTRONIC DATA PROCESSING WITHIN THE FRAMEWORK OF THE OFFICIAL DEPARTMENT FOR THE MEASUREMENT OF PERSONAL DOSES OF THE LAND BADEN-WUERTTEMBERG. Schellkes, A. (Landesanstalt fuer Arbeitsschutz und Arbeitsmedizin, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

A system of programs was developed by the official Department for the Measurement of Personal Doses of the Land Baden-Wuerttemberg in order to record the radiation exposure determined for every person under control in a file (tape file) for subsequent evaluation. This brings about a rationalization of the work to be carried out by the department for statistical and information purposes. Some of the problems encountered during the realization of the system, as well as some of its essential features, are given. (GE)

8407 (KFK-1638, pp 207-220) FUTURE TENDENCIES IN PERSONAL DOSIMETRY. Piesch, E. (Kernforschungszentrum, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The present status of personnel dosimetry is unsatisfactory with respect to organization, number of dosimeters, and measuring accuracy. Based on the criteria for radiation hazards, the possibilities for future personnel monitoring are discussed. Emphasized is a simplification of the present expenditure for routine monitoring and an improved measuring technique for people with increased radiation risk. The discussion further entails the enhancement of measuring accuracy, the influence of body size, and automated data evaluation. (tr-auth)

8408 (KFK-1638, pp 261-284) OCCUPATIONAL RADIATION INJURIES IN THE FEDERAL REPUBLIC OF GERMANY FROM 1953 TO 1969. Rahm, G. (Staatliche Gewerbearzt, Duesseldorf). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

Among the 150 cases under investigation, there were two cases of general radiation sensitivity, 48 cases of acute skin injuries, 50 chronic skin lesions, three cases of skin injury together with other conditions due to the radiation injury, 24 cases of changes in the blood picture including four cases of leukemia, 12 bronchial carcinomas in miners working in uranium mines, and another 11 cases of various radiation injuries. Fifty nine persons have been adjudicated pensions. Malignant tumors were found in 32 cases. In 16 cases, the radiation injury led to death, and one person committed suicide. The injuries were caused by: x-ray microscopic devices (30 times); various kinds of x-ray apparatus (8 times); x-ray units used in medicine (diagnostics and therapy) (68 times); unsealed radioactive substances (22 times); sealed sources (23 times); and accelerators (3 times). Four persons were working with x-ray devices as well as with radioactive substances. The professions concerned were: physicians (41); medico-technical assistants or radiographers (20); nurses (12); physicists (12); miners (12); experts in materials testing (10); laboratory assistants (7); engineers and technicians who are experts in x-ray technology (6); graduated engineers (5); electrical engineers and technicians (5); and a variety of 17 other professions (20). (GE)

8409 (KFK-1638, pp 285-290) RADIOLOGICAL SURVEILLANCE AND ITS EFFICIENCY. Moehrle, G. (Kernforschungszentrum, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

Experience with and aspects of radiological surveillance by radiologists is discussed on the basis of a statistical evaluation of more than 39,700 radiological investigations made in the Nuclear Research Centers, Juelich and Karlsruhe, with a view to objections made for reasons of health. Furthermore, it deals with problems arising in the radiological and medical surveillance of external maintenance and repair personnel working in nuclear facilities. Finally, some suggestions are made as to further improvements in radiological surveillance. (GE)

8410 (KFK-1638, pp 291-311) ORGANIZATIONAL AND PRACTICAL ASPECTS OF RADIATION PROTECTION IN A DEPARTMENT FOR NUCLEAR MEDICINE. Kaul, A.; Oeff, K. (Freie Univ., Berlin). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The use of radioactive materials for diagnostic and therapeutic purposes as well as in medical research calls for extensive measures to protect the individual and the general public against damage by radioactive irradiation. Radiation protection in practical nuclear medicine has to be organized in accordance with the special conditions of a clinic, i.e., it must be guaranteed that the every-day work in a clinic, especially the medical care for patients, will continue as undisturbed as possible, with the best possible protection for the persons involved in this work, as well as for the general public. Taking the Klinikum Steglitz of the Freie Universitaet, Berlin, as an example, the arrangement of rooms and laboratories in a modern department for nuclear medicine, including the sections diagnostics, therapy, physics, radiochemistry, experimental nuclear medicine, and laboratories for guest-scientists, in compliance with the requirements of radiation protection, as well as the organization of protective measures and the experience gained during the last three years, is described. (GE)

8411 (KFK-1638, pp 313-321) INCORPORATION MONITORING: PURPOSE AND PERFORMANCE. Schieferdecker, H. (Kernforschungszentrum, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

A survey is given of the legal provisions of the FRG, the GDR, Austria, and Switzerland with regard to incorporation monitoring. The regulations contained in the Radiation Protection Ordinances are discussed with a view to their usefulness and feasibility, as compared to the practical experience gained so far. It is suggested that in order to improve the usefulness of controls, the standard check-ups such as whole-body measurement and urine analysis should be supplemented by further measures such as on-the-job controls, air monitoring, nose swabs, and analysis of excrements. This is followed by a discussion of the experience gained so far during the performance of incorporation controls within the nuclear research center Karlsruhe. (GE)

8412 (KFK-1638, pp 325-326) REPORT ON CLOSING SESSION. Kiefer, H. (Kernforschungszentrum, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

Education about radiation effects is discussed. It was concluded that the courses for technicians in radiation protection must be improved. A brochure of instructional material is being prepared. Also discussed is familiarization with radiation protection of personnel involved in repair work in nuclear installations. With respect to education of the general public, emphasis is placed on physicians and teachers as opinion leaders. At the present time, a motion picture is being prepared that treats radiation ecology as a reply to opponents of nuclear energy, and which will be distributed to high schools and universities. (HBG)

8413 (LA-5180-C) CONFERENCE ON PARTICLE ACCELERATORS IN RADIATION THERAPY, OCTOBER 2-5, 1972, LOS ALAMOS SCIENTIFIC LABORATORY, NEW MEXICO. Partridge, S.; Harper, K. H. (eds.). (Los Alamos Scientific Lab., N. Mex.). Mar 1973. 165p. (CONF-721045-; EANDC(US)-180-U; INDC(USA)-55-U). Dep. NTIS $3.00.

Separate abstracts were prepared for 11 papers presented at this conference. Abstracts prepared previously for two papers appeared in NSA Vol. 27 as numbers 9840 and 12276. (CH)

For abstracts of individual papers see: 8337-8339, 8414-8417, and 9881-9884.

8414 (LA-5180-C, pp 28-38) REVIEW OF THE BASIS OF HEAVY PARTICLE THERAPY AND PAST CLINICAL TRIALS. Fowler, J. F. (Mount Vernon Hospital, Norwood, Eng.). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2–5, 1972, Los Alamos Scientific Laboratory, New Mexico.

Applications of heavy charged particle beams in radiotherapy are discussed and the biological and physical characteristics of fast neutrons, helium ion beams, proton beams, and deuteron beams are compared with conventional γ and x radiation and supervoltage x radiation in relation to dose distribution, LET, and oxygen enhancement ratio. Clinical trials of fast neutrons, helium ions, and protons are reported. It is concluded that results will have to be evaluated in more patients and over a longer time span before data on their effectiveness are available. The rationale for using negative π mesons for therapy is reviewed. (CH)

8415 (LA-5180-C, pp 75-81) DELIVERY OF CHARGED PARTICLES FOR RADIOTHERAPY. Berley, D. (Brookhaven National Lab., Upton, NY). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2–5, 1972, Los Alamos Scientific Laboratory, New Mexico.

Phenomena that limit the precision with which the radiation dose can be deposited in deep seated neoplasms are examined in relation to the effectiveness of charged particle beams for radiotherapy. It is concluded that pions and heavy ion beams are likely to be more effective than photon beams since the dose can be delivered precisely to the tumor volume in such a way that sensitive normal tissues can be spared and the ionization density or LET is more favorable for cell killing in the neoplasm. (CH)

8416 (LA-5180-C, pp 82-87) NEUTRON DELIVERY. Theus, R. B. (Naval Research Lab., Washington, DC). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2–5, 1972, Los Alamos Scientific Laboratory, New Mexico.

Criteria for neutron beams suitable for radiotherapy are reviewed as a factor of depth-dose distribution, tissue dose rate, radiation scattering from tissue in the beam, the reproducibility of the total dose delivered to the neoplasm, and the γ component of the beam. It is concluded that neutron generators are now available that meet the criteria and that clinical radiotherapy trials should be made. (CH)

8417 (LA-5180-C, pp 126-129) EARLY AND LATE TISSUE EFFECTS. Key, C. R. (Univ. of New Mexico, Albuquerque). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2–5, 1972, Los Alamos Scientific Laboratory, New Mexico.

Recent studies in the field of mammalian cellular radiobiology relevant to understanding the success or failure of radiation therapy in human patients are reviewed briefly. The need for the correlation of data on early and latent pathological changes in normal parenchymal and supporting tissues with the radiation dose to which they were exposed during therapy is stressed. It is pointed out that this can only be achieved by collaboration between the radiation therapist and pathologists, since except in cases where therapy has failed, the changes may not be observed for many months or years following irradiation. It is proposed that slow-growing spontaneous tumors in dogs be used to evaluate the effectiveness of new sources of radiation for therapy and that animal experimental models be established for radiobiological studies with 250 kVp x radiation or ^{60}Co γ radiation used as the standard for comparative purposes. (CH)

8418 (AD-754546) RADIOACTIVE THORIUM IN GLASS LENSES OF STARLIGHT SCOPES. Kronenberg, S.; Lux, R. A.; Ramm, W. J.; Pfeffer, R.; Santoro, R. (Army Electronics Command, Fort Monmouth, N. J.). Nov 1972. 59p. (ECOM-4045). NTIS.

Tests performed upon eyepieces of Starlight scopes revealed significant emission of nuclear radiation by radioactive thorium contained in the glass lenses. Quantitative measurements indicated that the dose which would be deposited within the human eye by some lenses can exceed maximum permissible levels. Methods to reduce the dose below these levels are suggested. Pertinent background material on radiation protection regulations, radioactive equilibrium, and ophthalmology is included for reference.(auth)

8419 TREATMENT OF CARCINOMA OF THE UTERINE CERVIX USING TELE-CESIUM UNIT. 2. Clinical Application. Kadota, T.; Tateyama, H.; Yahiro, T.; Yamada, S.; Adachi, N.; Kajiwara, K.; Katakura, Y.; Korenaga, M.; Noda, I. (Kyushu Univ., Japan). Nippon Gan Chiryo Gakkai-Shi; 7: No. 3, 204-217(Sep 1972). (In Japanese).

On the bases of clinical experiences, therapeutic effects and injuries or complications are reported. Analyzing 329 cases treated in the years 1955 to 1965, 5 years survival rates elevated about 10% in patients (110 cases) treated by cesium γ ray compared with the orthovoltage x-ray group (219 cases). Radiation sickness was manifested in 56.2% of the radiation alone group and in 73.8% of the postoperative irradiation group, leukopenia occurred in 38.5% of cases counting over 6000 before treatment and in 75.0% of cases under 6000 before therapy. Skin reactions during radiotherapy increased following increase of skin doses in both groups of radiation only and postoperative irradiation, also pigmentation and subcutaneous induration increased in proportion to skin dosage. Bladder reactions during the radiologic treatment occurred in 71.8% and radiation injuries of bladder encountered after treatment were in 18.9%, but the incidence of these complications did not correlate with radiation dosage. Apparent changes in upper urinary tract were not observed after radiation. Rectal reactions during treatment occurred in 72.4%, radiation injuries of the rectum occurred in 50.9% but the incidence increased out of proportion to the rectal dosage. It is important for improving the results of radiotherapy for cervical cancer to prevent the troubles of radiotherapy by individualization of therapeutic planning. (auth)

8420 RADIOLOGICAL PROTECTION IN THE USE OF X-RAY FLUORESCENT ANALYSIS. Musilek, L. (CVUT-FJFI, Prague). Radioisotopy; 13: No. 6, 1169-1190(1972). (In Czech).

An account is given of the safety precautions necessary for the safe use of the x-ray fluorescent method using a wide range of radionuclides. The application of the general principles is illustrated on the commercial x-ray fluorescence probe of Nuclear Enterprises NE 5527 with ^{241}Am and the doses measured in the vicinity of the probe are reported. Film dosemeters in standard badges were used as dose detectors. The results confirmed that the use of this method is entirely safe. (auth)

8421 LOCAL RADIATION INJURY AND ITS SURGICAL TREATMENT. Report of 170 Cases. Holmstroem, H.; Johanson, B. (Sahlgrenska Sjukhuset, Goeteborg). Scand. J. Plast. Reconstr. Surg.; 6: No. 2, 156-164(1972).

One hundred and seventy cases of local radiation injury were treated by excision and immediate covering of the defect by various reconstructive methods. Initial diagnosis was in 32% benign diseases, in 44% skin carcinomas, and in 24% deep malignant tumors. Postoperative histological diagnosis was nonulcerated atrophy in 24%, atrophic ulceration in 45%, necrotic ulceration in 9%, and radioinduced malignancy in 22%. The mean interval between radiation and operation was 12 yrs in cases of malignant injury. In 81%, irradiation had been given to the head and neck area and in only 6% to extremities. Basal cell carcinomas were six times as common as squamous cell carcinomas. The mean number of operations per patient varied from one with reconstruction by direct suture to eight by bone grafting. Cases of malignancy generally required more operations. The mean time of post-operative control until the patient was considered cured was 1.6 yrs in nonmalignant cases. Malignant cases are controlled for the rest of their lives. The mortality rate in radioinduced malignancy was 2.7%. One patient died during the postoperative recovery period. Surgical treatment is considered in regard to its timing and indications for different methods of reconstruction. (auth)

8422 PRE-IRRADIATION QUALITIES OF A PAROTID GLAND PREDICTING THE GRADE OF FUNCTIONAL DISTURBANCE BY RADIOTHERAPY. Eneroth, C. M.; Henrikson, C. O.; Jakobsson, P. A. (Karolinska Sjukhuset, Stockholm). Acta Oto-Laryngol.; 74: No. 6, 436-444(Dec 1972).

In the irradiation of head an neck tumors, often more than one of the major salivary glands and also many of the minor salivary glands are located within the therapy beams. This might then explain any functional disturbance of the salivary gland tissue causing xerostomia with difficulties in swallowing, a high incidence of caries, etc., after radiotherapy in this region. As the grade of these complications shows a great interindividual variation, it is questioned whether there is an individual sensitivity to irradiation therapy of the salivary gland tissue. To ascertain whether it is possible to predict in which patients radiotherapy will be more liable to cause a functional disturbance, a study was made of 15 parotid glands located within the therapy beams at radiotherapy of malignant head and neck tumors to find whether any correlation exists between the pre-irradiation quality of the glands and their reaction to irradiation at different doses. The pre-irradiation quality of the parotid glands was studied by sialography and sialometry, and their function during the irradiation period by sialometry during stimulation of the secretion rate with 1% citric acid. The present study shows so great an interindividual variation in the decrease of the stimulated secretion rate at irradiation that it seems impossible to estimate a definite critical dose level for

extinction of parotid glands. It has, however, also been shown that the pre-irradiation qualities of the parotid glands provide valuable information about the individual reaction of the parotid glands to irradiation. These findings are important for determining the risk of complications in the mouth and throat by radiotherapy of malignant tumors in the head and neck region. (auth)

8423 RADIOBIOLOGICAL PRINCIPLES IN RADIATION HYGIENE. Cas. Lek. Cesk.; 109: No. 42, 986-988(1970). (In Czech.).

The principles of radiation hygiene are derived from radiobiological data. Radiation hygiene deals with detection of early and delayed somatic manifestations in exposed persons as well as with organizational and technical measures for decreasing personal exposure. Valuable information can be obtained mainly from radiobiological studies that investigate the frequency of delayed effects as related to the dose and its space and time distribution. The simplest model of exposure inducing delayed effects is a single whole-body irradiation with a sublethal dose. It is necessary to consider the factors making it possible to increase the total radiation dose, without, however, producing early losses due to development of acute postirradiation syndrome. Radiation hygiene assembles and interprets data on the correlation of the dose and its effect that can be used in quantitative evaluation of the hazard. (auth)

8424 HISTOPATHOLOGICAL AND ROENTGENOLOGICAL STUDIES ON THE EFFECTS OF IRRADIATION ON HUMAN ADULT MANDIBLES IN CANCER OF THE ORAL REGION. Nizuno, A. (Tokyo Medical and Dental Univ.). Kokobyo Gakkai Zasshi; 39: No. 3, 489-518(Sep 1972). (In Japanese).

Radiation injuries of the bone after radiotherapy for cancer of the oral region were studied on human adult mandibles taken from operated cases (31 irradiated and 14 control cases) and an autopsy case (an irradiated case) during 5 yrs and 3 months, using decalcified stained sections, microradiograms, and x-ray films of the disected mass. In the paradentium, the alveolar bone exhibited highly irregular resorption. In the periosteum, osteoblasts and fibrocytes decreased and the fibres were hyalinized. In the substantia corticalis and crista, resorptive changes in the bone or enlarged lacuna were observed. Proliferation of the substantia spongiosa and of external substantia corticalis, increasing substantia compacta and the stenosis of the Haversian and Volkmann's canal were seen. In the cavum medulare, canalis mandibulae, and absorption lacuna, fibrination, inflammatory cells infiltration, and softening of the tissue were observed. Hyperplasia of the intima of the inferior alveolar artery and arterioles, obstruction of the lumen, disorder, destruction and softening of the elastic fibers, and obstruction of the vessels in the Haversian canal and Volkmann's canal were observed. Concerning the x-ray findings, the cases in which resorptive and sclerotic changes coexisted irregularly were seen very frequently. The degree of these changes in the mandible was relatively related to the local clinical findings. (Japan)

8425 RECOMMENDATIONS FOR SAFER ORAL RADIOLOGY. Freedman, M. L. (McCook Hospital, Hartford, CT). J. Conn. State Dent. Ass.; 46: No. 3, 130-136(Jul 1972).

Radiation doses from dental procedures should be incapable of producing dramatic, acute, biological damage. However, repeated exposures of the facial area are not insignificant, and it remains the responsibility of the practitioner to do all possible to reduce the radiation dose received by the patient through the use of faultless equipment and techniques. Steps designed to reduce personnel exposure during radiography are also discussed. (auth)

8426 HEALTH HAZARDS OF THE HUMAN ENVIRONMENT. Geneva; World Health Organization (1972). 387p. $11.00.

The publication consists of four parts. In Part I environmental hazards are considered in relation both to such physical aspects of the environment as air, water, food, soil, and land and to others less easy to quantify, such as the home and the place of work. Part II is devoted to a discussion of specific chemical contaminants and physical hazards present in the environment. Mutagens, carcinogens, teratogens, pesticides, and ionizing radiation are dealt with as groups because of the special problems they pose. Particular attention is paid to the problems involved in interpreting the results of laboratory tests, since these tests form the basis of most decisions to limit or prohibit the use of particular substances. The development of a world system of surveillance and monitoring of environmental factors affecting health is the subject of Part III. Such a network will be able to take advantage of the recent remarkable achievements in methods of accumulating, organizing, and handling data making use of systems theory and electronic computers. In Part IV environmental health hazards are viewed from the standpoint of the action that can be taken to deal with them. Great importance is attached to the development of criteria and standards that could be generally applied in, for example, air and water pollution and food contamination. Political, economic, and cultural differences make this difficult, but it has proved possible to draw up valuable criteria and standards of this nature in certain instances. Part IV also includes a discussion of the role of basic sanitation in solving many problems in the control of communicable disease, and some indications of the ways in which advanced technology may be used for controlling certain pollutants and nuisances. (auth)

8427 RADIOPROTECTION PRACTICE IN EDF NUCLEAR POWER PLANTS. Chanudet, I. (Electricite de France, Saint Denis); Beau, P. Rayonnements Ionis. Tech. Mes. Prot.; No. 1, 17-26(Jan 1973). (In French).

The exploitation of the following reactors: Chinon-1, Chinon-2, Chinon-3, Saint Laurent-1, Saint Laurent-2, Bugey-1 and Chooz emphasized the contamination or irradiation risks from radioactive effluents to which working personnel and the population are exposed. In consequence, the EDF has developed appropriate radioprotection facilities. In the field of health physics, measures were taken to avoid accidents (administrative measures authorizing the work, fixed instrumentation, movable instrumentation) and to ensure protection in normal operation (monitoring of the activity of the primary circuit, administrative measures authorizing the work, radiation detection, utilization of protective clothing or respiratory apparatus). The means used to protect the environment vary according to whether the transfer of radioelements occurs in the form of gaseous wastes or liquid wastes discharged into surface water. The radiation protection organization tries to instill a sense of responsibility in each member of the personnel. Each member of the personnel must thus be given a professional foundation in the field of radiation protection. (France)

8428 RADIATION. Radiographers Exposed to Excessive Radiation. Accidents (London); No. 94, 29-32(Jan 1973).

Brief descriptions of a number of cases where sources of radiation have been involved in some mishap or other are given. They are all concerned with the process of radiography using either radioactive sources or an x-ray machine. (auth)

8429 RADIATION QUALITY AND ANODE EFFECT IN DIAGNOSTIC ROENTGENOGRAPHY IN HIROSHIMA AND NAGASAKI. Antoku, S.; Sawada, S.; Russell, W. J.; Wakabayashi, T.; Mizuno, M.; Suga, Y. (Atomic Bomb Casualty Commission, Hiroshima). Health Phys.; 24: No. 6, 611-617(Jun 1973).

Hiroshima and Nagasaki medical institutions were surveyed for technical factors used in diagnostic x-ray examinations and for estimates of dose to patients. Collimators allowing female gonads to be in the direct beam were used in half of the routine chest roentgenographic units. Aluminum filtration of 0.5 mm thickness was most frequently used in both cities, although short of governmental regulations. The measured half-value layers (HVLs) were less than 2.0 mm aluminum for the majority of units. Radiation output measurements showed that large errors may occur in estimating patient doses without correcting radiation output, though some correlation between tube voltage and radiation output was observed. Gonadal doses were much affected by the anode position, particularly for males. In half of the units, anodes were positioned caudad of the examinee, incurring less dose to the gonads. Utilization of these data may be used to reduce unnecessary x-ray exposure. (auth)

8430 TREATMENT OF SIDE EFFECTS INDUCED BY RADIATION THERAPY. Yamashita, H.; Yoshioka, T.; Tanaka, Y. (Keio Univ., Tokyo). Rinsho Fujinka Sanka; 26: No. 9, 765-771 (Sep 1972). (In Japanese).

Side effects of radiation therapy such as effects on the hematopoietic organs, radiation sickness, effects on the skin, digestive disturbances, bladder impairment, bone changes, disturbance of growth, and impairment of the genital organs are described and the method for the prevention and treatment are also reported. Effects on the hematopoietic organs are generally noticed through leukopenia, but it is necessary to know the number of leukocytes before the beginning of the therapy, because there is an individual difference in the number. If some drugs are employed for increasing leukocytes, it will be more effective to use them from the beginning of the therapy in order to prevent leukopenia. Effects on the skin consist of three categories; acute, subacute, and chronic. Each type has quite different stages and is furthermore classified into four grades respectively based on the skin dose and the length of the latent period. Chronic disturbances are caused either by a long-term repeated exposure or by prolongation of acute or subacute disturbances. They are, however, little seen today. Effects on the skin should be, if chronic, treated with surgical operation, radiation or the combined treatment of operation and radiation. Among digestive organs the rectum is most easily affected by cavitary internal irradiation from a small radiation source. Diar-

rhea or intestinal hemorrhage often occurs. The performance of radiation therapy is closely related with the prevention of its side effects and much attention should be given to the prevention of sequelae. (JA)

8431 NURSE IN AN IONIZING-RADIATION THERAPY CENTER. Duroux, J. Cah. Med. interprof.; No. 44, 23-29(1971). (In French).

The 30 nurses in a radiotherapy center were subjected to three types of exposure: x rays, sealed sources, and unsealed sources. The hazards may be related to the ionizing radiation directly (external, skin or internal contamination) or indirectly (psychic disorder), or related to the workplace (claustration, excessively high temperature, visual fatigue). The selection examination includes a detailed medical history, a clinical examination (vision, mouth, respiratory system, blood, liver, kidney, genital system, skin, bones) and a thorough psychological study. Strict medical supervision is backed up by technical supervision: a hazard record covering exposure times, use of personal scintillation or film-badge dosimeters, checks on source leakage and monitoring of areas of maximum exposure. The value of these measures has been demonstrated over a 5-year period. (Occup. Saf. Health Abstr.)

8432 MYELOTRANSPLANTATION IN RADIATION AND CHEMOTHERAPY. Baisogolov, G. D.; Zhukovskii, I. Ya. Vop. Onkol.; 18: No. 10, 89-100(1972). (In Russian).

A survey was made of the literature on bone marrow transplantation during radiation and chemotherapy. The use of allogeneic and autologous bone marrow, and automyelotransplantation and some basic indicators during chemotherapy are discussed. 131 references. (KSW)

8433 GENETICALLY SIGNIFICANT DOSE OF RADIATION RECEIVED BY THE POPULATION OF LENINGRAD DURING X-RAY EXAMINATIONS. Cherpak, V. V.; Fedorchuk, A. A. (Kiev Medical Inst.). Gig. Sanit.; No. 4, 88-91(Apr 1973). (In Russian).

Data were collected on men and women of three age brackets from the Leningrad population with respect to the annual genetically significant dose of x radiation received during diagnostic examination of specific areas of the body. Recommendations are made and discussed for reducing the radiation dose received under these circumstances. (KSW)

8434 EFFECTS OF INHIBITORS ON REPAIR OF DNA IN NORMAL HUMAN AND XERODERMA PIGMENTOSUM CELLS AFTER EXPOSURE TO X RAYS AND ULTRAVIOLET IRRADIATION. Kleijer, W. J. (Dept. of Cell Biology and Genetics, Rotterdam); Hoeksema, J. L.; Sluyter, M. L.; Bootsma, D. Mutat. Res.; 17: No. 3, 385-394(Mar 1973).

Experiments were carried out to obtain direct evidence for the hypothesis that in human cells the repair of uv-damaged DNA is initiated by an incision step, and that this step is defective in cells from patients having Xeroderma pigmentosum (XP). The alkaline sucrose gradient centrifugation technique was used to detect breaks in the DNA. A decreased sedimentation velocity of the DNA was found after exposure of normal and XP cells to high doses of uv (5000 erg/mm^2). Breaks were induced in the DNA by the uv irradiation without the action of an enzyme. After exposure of both types of cell to uv doses of 100 to 500 erg/mm^2, breaks that might occur by enzymic incision were not observed, possibly because of immediate rejoining. After single-strand breaks were induced by x rays, rejoining did not occur at temperatures lower than 22°. Rejoining was inhibited by KCN, 2,4-dinitrophenol, EDTA, iodoacetate, and crystal violet. Actinomycin D, acriflavine, and phleomycin, also tested as potential inhibitors of the repair process, induced breaks or conformational changes in the DNA of unirradiated normal and XP cells. Application to uv-exposed cells of conditions that inhibit the rejoining of breaks did not cause accumulation of breaks in the DNA. The results suggest a coordinated and sequential performance of the steps in the repair of each uv lesion by repair enzymes that may act as a complex. (auth)

8435 ABERRATIONS INDUCED BY FISSION NEUTRONS IN HUMAN PERIPHERAL LYMPHOCYTES. Todorov, S.; Bulanova, M.; Mileva, M.; Ivanov, B. (Inst. of Radiology and Radiation Hygiene, Sofia). Mutat. Res.; 17: No. 3, 377-383(Mar 1973).

Analysis of dose-response relationships was carried out for chromosome aberrations produced in human peripheral lymphocytes by fission neutrons at doses of 25, 50, 100, or 200 rad. Statistical treatment showed experimental data to be fitted by a regression curve described by the mathematical model $Y = a + bD$. A linear relation to dose characterized both one-break and two-break aberration yields. Numerical values of coefficients are reported for yields of dicentrics, chromosome fragments, minutes, aberrant cells, total number of aberrations, and total breakage. Based on chromosome fragments and aberrant cells, relative biological efficiency (RBE) value derived for fission neutrons relative to 180 kV x rays for chromosome fragments was 2.53, and for aberrant cells it was 2.80. (auth)

8436 CHROMOSOME ABERRATIONS INDUCED IN HUMAN PERIPHERAL BLOOD LYMPHOCYTES USING HEAVY PARTICLES FROM $^{10}B(n,\alpha)^7Li$ REACTION. Vulpis, N. (CSN, Rome). Mutat. Res.; 18: No. 1, 103-111(Apr 1973).

The relationship between α-particle dose and chromosome aberration yield was studied in human peripheral blood leukocytes cultured in vitro. The α irradiation was produced from thermal neutron capture by boron, according to the nuclear reaction $^{10}B(n,\alpha)^7Li$. Blood samples containing 49 μg ^{10}B per ml were exposed to the thermal neutrons in a reactor at a flux density of $2 \cdot 10^7$ n/cm^2 s. By subtracting the rad dose due to the reactor radiations alone from that due to both boron capture and the reactor radiations, the rad dose rate of heavy particles was estimated. The dicentric yield appeared to follow a linear response up to about 18 rad and then showed signs of saturation. Comparison with 250 kV x-ray data (doses up to 510 rad) gave an RBE of 22.97. (auth)

8437 RADIONECROSES OF THE SKIN. A Task for Medical Cooperation. Drepper, H.; Ehring, F.; Vojtech, D. Med. Welt; 5: 155-162(1971). (In German).

Radionecroses are usually the result of a combination of damages. Some uncommon secondary causes include: tension due to preceding operation or secondarily due to fat deposition; allergies; corticosteroid allergies; liver damage; and peripheral circulatory insufficiency. Conservative therapy, individually suited, or restorative plastic surgery often facilitate recovery. A step by step epithelialization with grafts of epidermis is indicated for certain cases in addition to the different well-known methods of the free and pediciled plastic operation. In some cases, plasticepithesis complete the restoration. The interdisciplinary cooperation of dermatologists, plastic surgeons, internists, and social workers is often required in the treatment and rehabilitation of radionecroses. (ERB)

8438 CHROMOSOME ABERRATIONS AFTER X-RAY THERAPY. Kucerova, M. (Inst. of Biology and Genetics, Prague). J. Genet. Hum.; 18: No. 1, 21-29(1970).

A significant gradual rise in the number of lymphocytes with chromosome aberrations was found in peripheral blood samples from patients following a total skin dose of 16,000 R of fractionated radiation administered after surgical removal of mammary neoplasms. Even at 35 and 69 weeks following the termination of x-ray therapy, this high incidence of aberrant mitoses did not return to normal in some patients. During the course of x-ray treatment, the number of lymphocytes with a model chromosome number did not vary significantly. The number of polyploid mitoses rose significantly during radiotherapy, dropping to normal after 35 weeks. In one patient, radiation probably produced a surviving clone of cells with a chromosomal aberration. (ERB)

8439 SOMATIC CELL MUTATION. Detection and Quantification of X-Ray-Induced Mutation in Cultured, Diploid Human Fibroblasts. Albertini, R. J.; DeMars, R. (Univ. of Wisconsin, Madison). Mutat. Res.; 18: No. 2, 199-224(May 1973).

We describe a system for detecting somatic cell mutation to 8-azaguanine (8AG) resistance in cultured, diploid human fibroblasts. Hypoxanthine-guanine phosphoribosyltransferase (HGPRT)-deficient, AG-resistant fibroblasts from boys with the X-chromosomal, Lesch–Nyhan (L–N) mutation served as one type of prototype mutant cells. Both spontaneous and x-ray-induced mutation were studied. Recovery of L–N cells was a function both of density of normal cells and of the AG concentration used for selection. Optimum recovery was achieved at an initial inoculum of 2×10^4 normal cells per 60 mm diameter culture dish and an AG concentration of 8×10^{-6} M. Efficiency of recovery was between 39 and 90% and controls to determine this efficiency were included in mutagenesis experiments. Attempts to free normal cell population of pre-existing AG-resistant mutant cells by pregrowth in HAT medium failed because, unlike L–N mutants, most spontaneous AG-resistant mutants can grow in HAT medium. Although pre-existing mutants probably caused overestimation, the average spontaneous mutation rate derived from our experiments was 4.5×10^{-6} per cell generation. Eliminating one large-yield experiment reduced this estimate to 1.9×10^{-6}. Clonal survival of cultured human fibroblasts as a function of x-ray dose was studied. X irradiation increased the mutation rate above spontaneous background. Minimum estimates of the increases were 1.13×10^{-9} per R per cell at 75 R, 7.49×10^{-8} per R per cell at 125 R, 6.87×10^{-8} per R per cell at 150 R, and 2.16×10^{-7} per R per cell at 250 R. The total mutagenic effect and the induced mutation rate appeared to be dose-dependent. Normal parental cell strains and their derived AG-resistant mutants had similar x-ray sensitivities indicating that x rays induced mutations rather than selected for pre-existing mutants. Because of the realism of the

cultured diploid, human fibroblast model vis-a-vis in vivo human cellular events, the mutation detection system described herein is proposed as being potentially useful for environmental monitoring. (auth)

Vertebrates

Refer also to abstracts 8241 and 8335.

8440 (AD-751504) BIOMETRICAL ANALYSIS OF BIOMEDICAL RESPONSE DATA. Technical Report, 16 January 1969–13 April 1970. Wall, F. (Dikewood Corp., Albuquerque, N. Mex.). Oct 1972. Contract F29601-69-C-0043. 45p. (AFWL-TR-70-28). NTIS.

The principal research centered on an effort to relate mean lethal radiation dose for sheep to the age of the subject at the time of radiation exposure. Animals of different ages were immediately available and it seemed that statistical consultation would be beneficial in several problem areas associated with such an experiment. Efforts concentrated on the experimental design and analytical procedures. (auth)

8441 (AD-752049) RADIOBIOLOGY OF LARGE ANIMALS. Annual Report. Jones, D. C. L.; Krebs, J. S. (Stanford Research Inst., Menlo Park, Calif.). Aug 1972. Contract DAHC20-70-C-0219. 54p. NTIS.

A review was completed of all experiments concerned with radioinduced lethality in sheep and conducted by the Naval Radiological Defense Laboratory and/or the Stanford Research Institute under the auspices of the Defense Civil Preparedness Agency. After consideration of a series of experiments involving sheep exposed at various continuous, intermittent, or combined irradiation schedules at dose rates of 4 R/hr or less, it appears that the major factor determining mortality in such experiments is the average dose per day over the entire exposure period, and not the specific dose rate during the irradiation itself. A mathematical model was developed that describes the dynamics of injury and repair as a function of daily average dose rate. (auth)

8442 (COO-3380-8) COMPARISON BETWEEN THE EARLY CELLULAR RESPONSE TO ELECTRON RADIATION AND THE PRODUCTION OF TUMORS. Sinclair, I. P. (New York Univ., N. Y.). Nov 1972. 112p. Dep. NTIS $7.75.

Thesis.

Radioinduced cell population changes in various epithelial components of the skin were compared with the subsequent production of tumors of different types. The dorsal skin of rats in the growing phase of the hair cycle was irradiated with an electron beam. Two penetration depths of the beam were used, one shallow (1.0 mm), which gave a lower dose to the follicle matrix than to the upper part of the follicle, and the other dose (2.0 mm), which gave an essentially uniform dose to the whole follicle. Doses of 1000, 2000, 4000, and 8000 rads were given. Size changes in the epidermis, sebaccous glands, and follicles were measured in histological sections obtained during an 85 day period post irradiation. The sizes were estimated by determining the number of eyepiece grid intersections contained within each structure in a series of microscopic fields. Cell loss and repopulation were measured biochemically during the first 10 days post irradiation. A high incidence of tumors was found following exposure to 1000 rads shallow dose. No correlation between acute or chronic damage and tumor incidence was found. Very few tumors were induced at 4000 rads shallow exposure. No association was found between tumor type and persistent hyperplasia. The incidence of keratinizing tumors was higher at 1000 rads deep exposure than at 4000 rads deep exposure, although hyperplasia was persistent. The results indicated the possibility of a population of stem cells susceptible to oncogenic transformation located at a relative shallow depth in the skin. (auth)

8443 EFFECTS OF THE JRR-1 IRRADIATION ON REPRODUCTIVE FUNCTION OF THE MOUSE. 5. Effects of the Fetal Irradiation on Postnatal Fertility and Fertility of Their Descendant. Tanaka, R.; Kashiwabara, T. (Ibaraki Univ., Ami, Japan). Nippon Chikusan Gakkai Ho; 43: No. 4, 169-174(Apr 1972). (In Japanese).

The effect of prenatal JRR-1 irradiation on postnatal fertility and reproductive functions of their descendants were investigated. The rate of parturition per mating after puberty was 80.0, 90.9, and 85.0% for the preimplantation period irradiation (Pre.), major organogenesis period irradiation (M. Org.), and fetal period irradiation (Fet.), respectively. Therefore, it was considered that the function of fetal irradiated gonad was normal. Median age in days at primipara was 94.5, 75.5, and 107.0 days for the Pre., M. Org., and Fet., respectively, and it was found that the Pre. and Fet. were late in puberty and it was considered that a reason for late puberty in the Pre. was retardation of ovarian follicle growth by damage of some primordial germ cell. After birth the prenatal irradiated fetus was followed by full-sib mating at puberty. The average litter size and sex ratio of offspring from the irradiated groups and control did not show large variation. The percentages of stillbirth in the Pre. and M. Org. were not different from the control but in the Fet. F_3 and F_4 generation showed high percentage (11.1%, 7.5%) as compared with the other generations and irradiated strains. Accordingly, it was thought that the JRR-1 irradiation had induced a recessive semilethal gene. The rate of raising of the irradiated strains was significantly lower than that of the control, therefore, it was considered that a recessive semilethal gene (different from the gene that induced stillbirth at the Fet.) was induced at prenatal irradiation. In the descendants of Pre., the F_4 generation was maintained, and in the M. Org. and Fet., F_3 and F_5 generations were kept up. These phenomena seemed to have been due to the accumulation of harmful recessive genes in later generation of the descendants of JRR-1 irradiated mice. (auth)

8444 LOCAL AND SYSTEMIC CONTROL OF GRANULOCYTIC AND MACROPHAGE PROGENITOR CELL REGENERATION AFTER IRRADIATION. Chan, S. H.; Metcalf, D. (Walter and Eliza Hall Inst. of Medical Research, Parkville, Australia). Cell Tissue Kinet.; 6: No. 2, 185-197(Mar 1973).

Agar cultures of C_{57}BL bone marrow cells were used to determine colony stimulating factor (CSF) and serum CSF-inhibitor levels in C_{57}BL and BALB/c mice following x-irradiation. Whole-body irradiation over a range 50 to 1200 rads caused an acute, dose-dependent rise in serum CSF levels and fall in CSF-inhibitor levels. The regeneration of granulocytic and macrophage progenitor cells (in vitro CFCs) in the femur after 250 rads whole-body irradiation was preceded or paralleled by a fall in serum CSF-inhibitors and a dramatic rise in the capacity of bone-adherent cells in the marrow ("stromal cells") to produce material with colony-stimulating activity. No comparable changes were observed in the activity of marrow haemopoietic cells during regenerating or in the lungs or spleen. A similar rise in the activity of bone-adherent cells was observed in shielded femurs during regenerating of in vitro CFCs. Regeneration of granulocytic and macrophage progenitor cells following irradiation could be regulated by fluctuations in circulating CSF-inhibitor levels and local production of CSF within the marrow cavity. (auth)

8445 EFFECTS OF JRR-1 IRRADIATION ON THE REPRODUCTIVE FUNCTION OF THE MOUSE. IV. Effects on Postnatal Development of Mice Following Prenatal Exposure. Tanaka, R.; Kashiwabara, T. (Ibaraki Univ., Ami, Japan). Nippon Chikusan Gakkai-Ho; 43: No. 3, 134-140(Mar 1972). (In Japanese).

Mice in various stages of pregnancy were exposed to radiation for 1 hr in the JRR-1 reactor. In comparison with controls, the number of offspring of mice exposed during the preimplantation period was 43.9%, that of mice exposed during the organogenesis period was 53.6%, and that of mice exposed during the fetal period was 81.3%. The rate of postnatal death was highest in mice exposed during the preimplantation period. Growth of mice exposed during the preimplantation period was faster than that of mice exposed at later periods. Dwarfism and microphthalmia were observed in mice exposed during the fetal period. (HLW)

8446 HAEMOPOIETIC DEFECTS IN MICE INFECTED WITH LYMPHOCYTIC CHORIOMENINGITIS VIRUS. 2. The Viral Effect Upon the Function of Colony-Forming Stem Cells. Bro-Joergensen, K.; Volkert, M. (Univ. of Copenhagen). Acta Pathol. Microbiol. Scand., Sect. B; 80: 853-862(1972).

Both haemopoietic and immunological defects as a result of LCM virus infection might be caused by some virus-induced interference with the stem cells in infected mice. Attempts were therefore made to estimate the numbers and the function of stem cells in mice infected with the LCM virus. Haemopoietic colony assays were employed, and both acutely infected mice and persistent, tolerant virus carriers were examined. The findings suggested a decrease in colony-forming stem cells in the bone marrow during the acute infection. However, the most striking observation in the acutely infected mice was a profound inhibition of the colony-forming response of stem cells in these animals. The influences exerted upon the stem cell response seemed to be quite specific, in that the response of immunocompetent cells was almost unimpaired when examined at the same time. The inhibition was not caused by a direct viral effect upon the stem cells, nor by any immune-mediated damage. Experiments with the adult, persistent, tolerant virus carriers indicated that the haemopoietic colony formation was not inhibited in these mice despite a pronounced viraemia. However, their numbers of colony-forming stem cells amounted to about fifty per cent of the normal values and seemed to agree with their relative increase in sensitivity to x rays. It is suggested that virus-induced interference with the function of haemopoietic stem cells plays a central role for the tolerogen effects of the LCM virus. (auth)

8447 EFFECT OF IRRADIATION ON ESTABLISHED DELAYED HYPERSENSITIVITY. Suppression of Skin Reactions, Recovery, and the Effect of Cell Transfer. Visakorpi, R. (Univ. of Helsinki). Acta Pathol. Microbiol. Scand., Sect. B; 80: 788-794(1972).

When rats immunized with bovine serum albumin in complete adjuvant were irradiated 10 days later with 800 rads their ability to display a positive skin reaction to the test antigen was suppressed for 4-5 days. Thereafter recovery was evident in spite of persisting low blood leucocyte levels. Specific cells were demonstrated in the animals by migration inhibition of peritoneal cells two days after irradiation, when skin reactions were negative. On the other hand transfer of normal bone marrow cells corrected the ability to mount skin reactions but spleen, thoracic duct, or lymph node cells did not. It seems that post-irradiation suppression of skin reactions does not depend on damage of specific cells but on shortage of a bone-marrow-derived cell type participating in skin reactions as a nonspecific component. (auth)

8448 UPTAKE OF GLUCOSE-^{3}H BY GLIA CELLS BEFORE AND AFTER RADIATION INJURY (X RAYS AND 14-MeV NEUTRONS). Lierse, W. (Univ., Hamburg). Virchows Arch., B; 11: 326-333(1972).

The effects of single doses of x rays and 14 MeV neutrons on the adult guinea-pig brain were studied by light microscopy and autoradiography. The importance of labeled glucose on glial metabolism and the damage caused by irradiation are described. After exposure to irradiation, the incorporation of glucose-^{3}H and its metabolites is not blocked only in glial cells that are filled with glycogen and glycoproteins. 14 MeV neutrons damage glial cells in the same manner as x rays, γ rays, fast electrons, or α particles. All kinds of glial cells, astrocytes, oligodendrocytes, ependymal cells, and Müller's cells in the retina, are injured. The cells of the white matter in the cerebrum and cerebellum are more sensitive to irradiation than those in fiber tracts of the basal-ganglia and thalamus. (auth)

8449 MORPHOLOGICAL AND ELECTRON-MICROSCOPIC STUDIES OF THE MYOCARDIUM OF DOGS EXPOSED TO A CHRONIC GAMMA IRRADIATION. Bespalova, L. A. Kosm. Biol. Med.; 7: No. 3, 26-30(1973). (In Russian).

A group of dogs was exposed to a chronic ^{60}Co γ irradiation with doses of 21, 63, 120, 125, and 190 rads per year. Simultaneously another group of dogs was exposed to a chronic 3-year irradiation with a total dosage of 560 rads and was treated specifically. The routine microscopic study of tissues of the myocardium of these dogs showed no pathological changes in muscular fibers, stroma, or intramural vessels. An electron microscopy of the myocardium revealed insignificant changes of the cell ultrastructure only in the dogs exposed to 190 rads per year and 560 rads per three years. These changes included high polymorphism of mitochondria and lysosomes. The number of lysosomes increased. Endothelial cells of capillaries showed enhanced micropinocytosis. (auth)

8450 INVESTIGATION OF PATHOGENIC FACTORS IN RADIOINDUCED FATTY DEGENERATION OF THE LIVER OF ALBINO RATS USING MATHEMATICAL SIMULATION ON AN ANALOG COMPUTER. Haude, W.; Wagner, H.; Hummel, L.; Donath, A. (Friedrich-Schiller-Univ., Jena, Ger.). Acta Biol. Med. Ger.; 29: No. 2, 231-237(1972). (In German).

Six hours following sham or whole-body x-irradiation (800 R) of Wistar rats Na-^{14}C-1 palmitate was injected intravenously. Subsequently, serum and liver samples were taken at intervals from 2 min to 5 hr in ether narcosis in order to measure concentrations and specific activities of free fatty acids and triglyceride fatty acids. Mathematical simulation of the isotope dilution curves was used to obtain information about turnover and flux rates of the fractions mentioned. Irradiation caused an increase in liver triglycerides of 130 percent over sham-irradiated animals, with the bulk of the accumulated fatty acids being contained in a pool of liver triglycerides which turned over slowly. The reason for this change was found to be an increase in flux rate of free fatty acids from the serum into liver triglycerides by 80 percent (= 0.8 μM/min). The process is facilitated, to some extent, by reduction of the flux rate of liver triglyceride fatty acids into the serum by about 25 percent (= 0.06 μM/min). (auth)

8451 RECOVERY OF IMMUNOLOGICAL FUNCTIONS OF MICE TREATED WITH IRRADIATED BONE MARROW AND THEN EXPOSED TO A LETHAL DOSE OF X-RAYS. Beaumariage, L.; Haot, J.; Betz, E. H. (Univ., Liege). Compt. Rend. Soc. Biol.; 166: No. 6, 965-968(1972). (In French).

Comparisons between different groups of irradiated mice and reference animals established the existence of a slight spleen hypertrophy with animals injected with normal marrow (alone or enriched with thymic cells) and immunized one day after the graft. This phenomenon is more tardive and less marked with animals injected with preirradiated marrow. At the same time, a more tardive complete recovery of the immunological capacities is observed. (France)

8452 CHANGES IN CONCENTRATION OF FREE AMINO ACIDS IN THE LIVERS OF RATS AFTER IRRADIATION AND PARTIAL HEPATECTOMY. Isvoranu, M. Stud. Cercet. Biol., Ser. Zool.; 21: No. 3, 251-257(1969). (In Rumanian).

The contents of some free amino acids in the liver of rats following x irradiation and partial hepatectomy are discussed. The amino acid balance in the experimental animals demonstrated a close relation between radiation dose and the mode of x-ray administration, which influences the regeneration of the liver following hepatectomy. (ERB)

8453 14-MeV NEUTRON IRRADIATION OF SWINE. Dosimetry and Clinical Response. Brown, D. G. (UT-AEC Agricultural Research Lab., Oak Ridge, TN); Haywood, F. F. Health Phys.; 24: No. 6, 627-636(Jun 1973).

Dosimetry, ^{24}Na activation in the blood, and clinical syndrome were studied in 28 swine exposed to 14-MeV neutrons. Tissue dose in air ranged from 216 to 877 rads; incident gamma and x rays accounted for 13.4% of the total dose. The $LD_{50/30}$ was calculated to be 585 rads with 95% confidence interval of 390 to 784 rads. Post-irradiation survival time ranged from 6 to 17 days, the average being 11 days. Relative biological effectiveness (RBE) values for mortality, based on comparison with gamma-irradiated swine, were less than 1 and these values varied with dose parameters compared. The postirradiation clinical syndrome varied somewhat to that of swine exposed to gamma radiation. The difference was related primarily to gastrointestinal damage that appeared to be more severe in the 14-MeV irradiated swine. (auth)

8454 ENHANCEMENT OF THE RADIATION LETHAL EFFECT UPON EHRLICH ASCITES TUMOUR CELLS BY AMINOHYDROXYTHYMINE HYDRAZINE. Mustea, I. (Oncological Inst., Cluj). Int. J. Radiat. Biol.; 23: No. 4, 409-413(Apr 1973).

An investigation was made of 5-amino-6-hydroxythymine hydrazine (AHTH) and its effects on the response of Ehrlich ascites tumor cells to whole-body x irradiation. Prior to irradiation, mice bearing ascites tumor cells were injected intraperitoneally with 100, 200, and 300 mg AHTH/Kg body weight dissolved in 0.5 ml saline. After 5, 15, 30, 60, or 120 min, the animals were irradiated with 1000 R x irradiation. Irradiation in the presence of AHTH showed a significantly enhanced effect at AHTH doses between 200 and 250 mg/Kg body weight administered at short intervals (5 to 15 min) before irradiation. The addition of glucose (4g/Kg body weight, 75 min before irradiation) to AHTH increased the response to irradiation. The dose-effect curve slopes were not, or only slightly, changed by administration of AHTH or AHTH + glucose, but the extrapolation numbers were reduced to 5.8 and 3.4 respectively, compared with the control value of 11.4. (UK)

8455 EFFECT OF 2450-MHz MICROWAVES ON THE RADIATION RESPONSE OF X-IRRADIATED CHINESE HAMSTERS. Lappenbusch, W. L. (Environmental Protection Agency, Rockville, MD); Gillespie, L. J.; Leach, W. M.; Anderson, G. E. Radiat. Res.; 54: No. 2, 294-303(May 1973).

More than 1000 female Chinese hamsters, 80 days old, were used to determine the effect of microwave treatment on the mortality and circulating blood response of x-irradiated animals subjected to microwaves immediately prior to or post exposure to x rays. Animals were exposed to 2450-MHz microwaves at 60 mW/cm^{2} for ½ hour in the far field when the ambient temperature (25°C), humidity (50%), and wind velocity (10 ft/minute) were held constant and to x-rays when the ambient temperature, relative humidity, and atmospheric pressure were approximately 22°C, 50%, and 745 mm Hg, respectively. Hamsters were subjected to the co-insults during that period of the day when the rate of mitosis of developing leukocytes in the bone marrow was at a peak, as previously reported by Lappenbusch, thus probably allowing for maximum stimulation and repair of recovery of the hematopoietic system by the microwave treatment. The x-ray $LD_{50(30)}$ was 821 or 824 rads from x-irradiation alone, was 811 rads when microwave radiation preceded the x-irradiation, but was significantly increased to 854 rads when microwave exposure was delivered 5 minutes after the x-ray exposure. This radioprotection is associated with the delayed drop in the number of circulating white blood cells, reduced period of low cell density, and complete replenishment of white blood cells within 30 days after the co-insults were administered. In addition, microwave treatment alone or in combination with an x-ray exposure increased the relative number of neutrophils, reduced the relative number of lymphocytes, and slightly increased the number of circulating red blood cells/mm^{3} blood. This favorable blood picture following the co-insult may well be due to the internal thermal stress of microwave treatment on the surviving viable bone marrow cells. (auth)

8456 EFFECT OF VARIATIONS IN LET AND CELL CYCLE ON RADIATION HEPATOCARCINOGENESIS. Wiley, A. L. Jr.; Vogel, H. H. Jr.; Clifton, K. H. (Univ. of Wisconsin, Madison). Radiat. Res.; 54: No. 2, 284-293(May 1973).

The effect of variations in LET and cell cycle on radiation carcinogenesis was studied in LAF_1/Jax mouse liver. Results are consistent with those of Cole and Nowell in that both the quality (LET) of the radiation and the addition of a proliferative stimulus significantly alter the hepatocarcinogenic endpoint. A single, whole-body, 200-rad dose of ^{137}Cs gamma rays increased the hepatoma incidence by approximately 3- to 4-fold over the control rates, when a pure proliferative stimulus (partial hepatectomy) was added. Also a single, whole-body, 200-rad dose of fission neutron irradiation increased the hepatoma incidence by approximately 6- to 9-fold over the control rate, when combined with partial hepatectomy. Furthermore, both the ^{137}Cs and fission neutron hepatocarcinogenic rates were enhanced regardless of whether the irradiation was given either during liver regeneration or 8–13 weeks prior to partial hepatectomy. However, neither ^{137}Cs nor fission neutron irradiation alone (i.e., without partial hepatectomy), significantly increased the incidence of hepatomas. The highest incidence of hepatomas observed was nine times the unirradiated control incidence and 50% greater than that in the next highest experimental groups, and occurred in mice irradiated with fission neutrons 24 hours after partial hepatectomy. The difference between this group and those irradiated with neutrons 36.5 and 43.5 hours after hepatectomy was not, however, statistically significant. These and other data indicate nonetheless that the role of the cell cycle phase in susceptibility to carcinogenesis warrants further investigation. (auth)

8457 EXPOSURE-RESPONSE CURVE FOR RADIATION-INDUCED LUNG TUMORS IN THE MOUSE. Yuhas, J. M.; Walker, A. E. (Oak Ridge National Lab., TN). Radiat. Res.; 54: No. 2, 261-273(May 1973).

Male RFM mice were given localized chest exposures of 750 to 3000 R of x rays, with and without injection of 400 mg of WR-2721 (S-2-[3-aminopropylamino]ethylphosphorothioic acid) before exposure, and were killed 11 months later for analysis of lung tumor patterns. By a technique of clearing and staining, lung tumors as small as 0.1 mm in diameter could be detected. Essentially no mortality occurred over this 11-month interval, so the data could be interpreted without the complication of premature removal; i.e., all mice were available for analysis. The incidence of lung tumors (and the mean number of tumors per mouse) was directly related to exposure over the range of 750 to 1500 R and then declined to control levels over the range of 1750 to 3000 R. Tumors occurred randomly among the members of an exposed group and were typical adenomas with various degrees of invasiveness. Injection of WR-2721 before exposure did not affect the incidence between 750 and 1250 R but was associated with a peak at 1250 R, as opposed to 1500 R in the nontreated mice; and the incidence in drug-treated mice was lower than that in nontreated mice at all higher exposures. The tracheobronchial lymph nodes were protected by WR-2721, and this protection may account for at least part of the effect of the drug on tumor incidence. (auth)

8458 PHARMACOLOGIC EFFECTS OF WR-2721: THEIR ROLE IN TOXICITY AND RADIOPROTECTION. Yuhas, J. M.; Proctor, J. O.; Smith, L. H. (Oak Ridge National Lab., TN). Radiat. Res.; 54: No. 2, 222-233(May 1973).

Injection of S-2-[3-aminopropylamino]ethylphosphorothioic acid (WR-2721) into BALB/c or $BC3F_1$ mice induces a dramatic vasodilation, which is most pronounced in the spleen. This response is a component of the drug's toxic mechanism, as evidenced by the fact that splenectomy increases the tolerance of the mice to the toxic effects of the drug. Further, removal of the spleen is associated with a reduced effectiveness of the drug in terms of radioprotection, which is similar to the effects of reduced oxygen tension. Thus, at least part of the superiority of WR-2721 as a radioprotectant is due to its ability to reduce peripheral oxygen tension. (HLW)

8459 EFFECT OF INTENSIVE ISOLATED IRRADIATION OF BLOOD ON THE METASTASIZING OF A BROWN–PEARCE CARCINOMA. Nesis, A. L.; Priev, I. G.; Danil'yan, V. M. Vop. Onkol.; 18: No. 10, 87-88(1972). (In Russian).

A group of 40 rabbits were given tumor grafts, following which blood was taken, irradiated (100 kR dose of x radiation), and then replaced in the same animals. The rabbits were sacrificed at 10, 20, and 25 to 30 days later. The experimental animals showed general areas of metastasis two-thirds of that in the controls. (KSW)

8460 DYNAMICS OF CHANGES IN THE OVARIES, HYPOPHYSIS, AND ADRENAL GLAND IN THE LATENT PERIOD OF RADIATION CARCINOGENESIS. Pavlenko-Mikhailov, Yu. N. (Inst. of Biophysics, Kiev). Vop. Onkol.; 15: No. 10, 87(1972). (In Russian).

The dynamics of morphological changes were studied in the ovaries, hypophysis, and the adrenal gland during the latent period (180 days) of radiation-induced tumor formation. White rats were irradiated with a 200-R ^{60}Co gamma (whole body) to dose. An interrelationship appeared in the morphological changes in the adenohypophysis and in the ovaries during the 180 days. (KSW)

8461 CHANGES IN THE REACTIVITY OF SMALL INTESTINAL RECEPTORS IN DOGS WITH ACUTE RADIATION SICKNESS. Pochechueva, G. S. Byull. Eksp. Biol. Med.; 75: No. 3, 48-51(Mar 1973). (In Russian).

Total x-ray irradiation of dogs (500 R) caused an increase in the reactivity of cholinosensitive and a fall in the reactivity of serotoninosensitive receptors of the intestinal loop isolated by the method of Thiry-Vella. No significant effect was produced on the reactivity of adrenosensitive receptors by irradiation of the animals. (auth)

8462 SUPPRESSION OF CHONDROCOCCUS COLUMNARIS IMMUNE RESPONSE IN RAINBOW TROUT SUBLETHALLY EXPOSED TO TRITIATED WATER DURING EMBRYOGENESIS. Strand, J. A.; Fujihara, M. P.; Templeton, W. L.; Tangen, E. G. (Battelle Pacific Northwest Labs., Richland, WA). pp 543-550 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB–313; CONF-720708-.

Antibody production in response to exposure to Chondrococcus columnaris infection (naturally occurring in the Columbia River) was employed to investigate the effect of tritium irradiation (1.0 μCi/ml and 10.0 μCi/ml for 20 d during embryogenesis) on development of immune response in juvenile and yearling rainbow trout, Salmo gairdneri. Rearing throughout embryogenesis was facilitated within a recirculating drip incubation system of 150 litre capacity containing tritium contaminated spring water. A standard tube agglutination test was employed to determine agglutinin values for fish serum samples. All groups exposed to tritiated water showed an increase in titer magnitude during the study. Control groups indicated that more fish demonstrated higher titers which suggests a suppression of the immune mechanisms in the tritium irradiated groups of data. A significant suppression of antibody development occurred in both juvenile and yearling groups. The data indicate that there is a carry-over of agglutinins developed as juveniles but more significantly a carry-over of the suppression mechanism. No significant difference was observed between the 1.0- and 10-μCi groups. (auth)

8463 EFFECT OF X RADIATION ON THE PIGMENT EPITHELIUM AND GANGLIONIC CELLS OF TADPOLE RETINA (RANA TEMPORARIA). Farberov, A. I.; Barybina, G. V.; Popov, V. V. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 206: No. 4, 1014-1017(1 Oct 1972). (In Russian).

Tadpoles (Rana temporaria) were given local doses of x radiation of 20, 400, and 1500 R in the right eye. Subsequently the central portions of the retina were photographed, and the lengths of the photoreceptors and the posterior segments of the pigmented epithelium were measured. The quantity of DNA was also estimated. The data indicated that the functional ganglionic cells of the retina were affected. The dose of 1500 R caused protracted damage to their functions; the 400 R dose lead to partial restoration in the course of seven days. (KSW)

8464 EFFECT OF IONIZING RADIATIONS ON GROWING BONE (EXPERIMENTAL OBSERVATIONS). Pini, M.; Martelanc, E. (Ente Reginale Ospedaliero, Trieste, Italy). Radiaz. Alta Energ.; 11: No. 4, 143-155(Oct 1972). (In Italian).

The effect of ionizing radiations on growing bone was investigated in rats irradiated on the tail at the age of three days. The growth was measured for 30 days. The results are graphed and show that in the irradiated animals the total length of the tail is less than that in the controls. A statistical study showed that the difference in growth values has no significance for the distal part of the tail whereas the difference is highly significant for the proximal part. (JSR)

8465 EFFECT OF SINGLE OR FRACTIONATED X IRRADIATION ON THE NPSH (NONPROTEIN-SULFHYDRYL) LEVEL OF RABBIT BLOOD. Chung, P. T.; Suh, S. J. (Kyungpook National Univ., Taegu, Korea). Taehan Naekwa Hakhoe Chapchi; 14: No. 2, 123-126(1971). (In Korean).

The effects of a single x-ray irradiation of 900 R (S) or a fractionated dose of 300 R (F) given each day for three days on the nonprotein-sulfhydryl (NPSH) level of the blood was measured at 1, 3, 5, 24, and 48 h post exposure in rabbits. NPSH level de-

creased significantly at 5 h in the S group. In the F group, NPSH levels were higher throughout the experiment than in the S and control groups. (ERB)

8466 CHANGES IN CIRCULATING BLOOD OF IRRADIATED MICE FOLLOWING BONE MARROW TRANSPLANTATION. Viktora, L.; Zoubkova, M. (Inst. of Haematology and Blood Transfusion, Prague). Folia Biol. (Prague); 19: No. 2, 148-152(1973).

Changes in the number of reticulocytes, leucocytes, and differential cell counts in circulating blood were investigated on days 9, 12, and 16 after bone marrow transplantation. The results were compared with changes in control, only irradiated mice. Circulating blood in the transplanted animals was found to differ appreciably from that in the controls: marked reticulosis was apparent on day 9 and also leucocytes and thrombocytes increased in number during the early period after transplantation. (auth)

8467 TISSUE LIPIDS IN LETHALLY X-IRRADIATED RATS. III. Changes in Adrenals, Kidneys, Heart and Skeletal Muscle, and Lungs. Ahlers, I.; Ahlersova, E.; Sedlakova, A.; Praslicka, M. (Safarik Univ., Kosice, Czech.). Folia Biol. (Prague); 19: No. 2, 135-139(1973).

Male Wistar rats were exposed to a single whole-body dose of 1,500 R of x rays and the lipid levels were determined in the adrenals, kidneys, heart and skeletal muscle, and lungs 2, 6, 24, and 72 hrs after irradiation. The typical stress kinetics of cholesterol concentration was demonstrated in the adrenals. In other tissues only the increase in cholesterol concentration was a uniform finding. The concentration of the lipoperoxides increased in the kidneys and heart muscle at the terminal time interval of observation. Generally, lipid changes of a smaller extent could be observed mostly at the terminal time interval shortly before death of the animals. (auth)

8468 TISSUE LIPIDS IN LETHALLY X-IRRADIATED RATS. II. Changes in Bone Marrow, Thymus, Spleen, and Testes. Ahlers, I.; Ahlersova, E.; Sedlakova, A.; Praslicka, M. (Safarik Univ., Kosice, Czech.). Folia Biol. (Prague); 19: No. 2, 130-134 (1973).

Male Wistar rats were exposed to a single whole-body dose of 1,500 R of x rays and the lipid levels were determined in the bone marrow, thymus, spleen, and testes. A pronounced accumulation of the triglycerides with unchanged or decreased concentration of the phospholipids appeared in the bone marrow and thymus. This marked increase of the triglyceride: phospholipid ratio is an important biochemical sign of postirradiation changes in these tissues. Changes in the thymus appear earlier, are more extensive and correlate well with the decrease in the relative weight of the organ. Changes in the lipid fractions in the spleen and testes are small, in the spleen being apparent only in the later phases after irradiation. (auth)

8469 TISSUE LIPIDS IN LETHALLY X-IRRADIATED RATS. I. Changes in Serum, Liver, White and Brown Adipose Tissue. Ahlers, I.; Ahlersova, E.; Sedlakova, A.; Praslicka, M. (Safarik Univ., Kosice, Czech.). Folia Biol. (Prague); 19: No. 2, 124-129(1973).

Male Wistar rats were exposed to a single whole-body dose of 1,500 R of x rays and the lipid levels were determined in the serum, liver, white and brown adipose tissue 2, 6, 24, and 72 hrs after irradiation. The decrease of lipids in serum with a simultaneous increase of free fatty acid concentration in white and brown adipose tissue and serum occurred 2 hrs after irradiation. Also, the amount of lipoperoxides in liver was decreased at this time interval. Lipid concentration in serum increased from 6 hrs, hyperlipemia reached a peak 72 hrs after irradiation when a simultaneous accumulation of triglycerides, cholesterol, and lipoperoxides in the liver was observed. Enhanced mobilization of free fatty acids plays an important role at the earlier time intervals after lethal exposure of rats to x rays. (auth)

8470 INTERFERON, NUCLEIC ACID, AND PROTEIN SYNTHESIS IN MOUSE SPLEEN CELLS AFTER ACUTE γ IRRADIATION. Talas, M.; Konstantinova, I.; Fuks, B. B.; Stoeger, I.; Szolgay, E. (Magyar Tudomanyos Akademia, Budapest). J. Gen. Virol.; 18: No. 3, 393-397(Mar 1973).

There is evidence that the spleen is one of the main sites of interferon synthesis. It was shown previously that although acute or fractional x or gamma radiation or acute proton irradiation causes a reduction in spleen weight, the synthesis of circulating interferon does not change and sometimes even increases when poly I: C or endotoxin was used as inducer. In this study, experiments were performed to determine the effect of gamma irradiation on the induction of interferon synthesis in spleen cells by poly I: C and Newcastle disease virus. The dynamics of interferon production were also correlated with nucleic acid and protein synthesis in spleen cells. It is suggested that the entire system of biochemical reactions mediating the induced synthesis of interferon was preserved in the radioresistant cell after irradiation. (UK)

8471 INFLUENCE OF THE REMOVAL OF SOME SECTIONS OF THE BLOOD-FORMING SYSTEM ON MARROW LYMPHOID POPULATION IN SUB-LETHALLY IRRADIATED MICE. Barakina, N. F.; Khao, Yu. (Inst. of Biology of Development, Moscow). Dokl. Akad. Nauk SSSR; 209: No. 2, 472-474(11 Mar 1973). (In Russian).

A group of eight-week old mice were given a 400 R dose of whole-body x radiation, and then divided into three groups: The spleen was removed 10 days after irradiation in the first group; a thymectomy was conducted on the second group, followed by subsequent removal of the spleen. The third group received no additional treatment. Bone marrow was extracted for examination. X-cells were formed immediately in the marrow of sublethally irradiated mice in the period of its regeneration; differences in this behavior in the case of each group are discussed. (KSW)

8472 EFFECT OF FRACTIONATED IRRADIATION ON RADIOSENSITIVITY AND THE COURSE OF REPAIR PROCESSES IN MOUSE ONTOGENESIS. Chudinovskaya, G. A.; Ivanenko, G. F. (Inst. of Biophysics, Pushchino, USSR). Zh. Obshch. Biol.; 34: No. 2, 305-314(1973). (In Russian).

The effect of single and fractionated radiation treatment in embryogenesis on postnatal development was studied. The weight of the body and other internal organs—testicles, spleen, liver, kidneys, adrenal glands, and thyroid in three month old animals was regarded as a criterion of radiation treatment damage. A single radiation treatment at doses of 100 and 150 R inhibited the development of the animals. On fractionated radiation treatment (50 + 50 R and 50 + 100 R), the interval between treatments being an hour, no fractioning effect was recorded. The intervals between treatments being 6, 17, and 20 hrs, a decrease of the radiation damaging effect was noted that manifested itself to a different extent in the organs under investigation. (auth)

8473 CHROMOSOME REARRANGEMENTS INDUCED IN THE MOUSE BY EMBRYONIC X IRRADIATION. II. Irradiation of Male Foetuses at the 13.5th Day of Gestation. Ivanov, B.; Leonard, A.; Deknudt, G. (CEN/SCK, Mol, Belgium). Mutat. Res.; 18: No. 1, 89-92(Apr 1973).

Pregnant females were exposed to 0, 100, 200, or 300 R of whole-body x irradiation at day 13.5 of pregnancy. Except for the dose of 300 R where only seven males were used, 10 males chosen from the litters of different females were sacrificed 100 days after birth and for each testis 100 dividing spermatocytes were examined for the presence of chromosome rearrangements. No chromosome rearrangement could be detected in the spermatocytes of adult male mice irradiated at the fetal stage. On the other hand, dividing spermatocytes are known to carry translocation configurations after exposure at the spermatogonial stage in the adult male mice. Thus large differences exist in this respect between the dividing gonocytes of the fetal male mouse and the type-A spermatogonia of the mature one. (auth)

8474 X-RAY-INDUCED SPECIFIC-LOCUS MUTATION RATES IN YOUNG MALE MICE. Selby, P. B. (Univ. of Tennessee, Oak Ridge). Mutat. Res.; 18: No. 1, 77-88(Apr 1973).

The specific-locus mutation frequency resulting from 300 R of acute x irradiation was determined for the germ cells present in male mice at 2, 4, 6, 8, 10, 14, 21, 28, and 35 days of age. The sample size was large enough for each of these nine age groups to ensure that a high mutation rate would be noticed. The testis of the mouse undergoes many developmental changes between birth, when most or all germ cells are gonocytes, and 35 days, when the cell population has come to resemble that of the adult. It was important to know if the germ cells present in these developmental stages of immature male mice yield the same mutation frequency as that found earlier for spermatogonia in the adult by W. L. Russell. None of the nine age groups has a mutation rate statistically significantly higher than that of the adult. Taken together, the nine groups of males have an average mutation frequency quite similar to that of the adult. This does not rule out the possibility that individual age groups may have a mutation frequency somewhat different from that of the adult. The distribution of mutations among the loci seems to be similar to that found for mutations induced in spermatogonia of the adult. Clusters of specific-locus mutations were found only on day 21. This paper and that presented earlier on the newborn report the first specific-locus mutation-rate studies on male mice irradiated between birth and adulthood. If the results can be carried over to man, it can be concluded that irradiation of the immature testis,

from birth to puberty, will not present any greatly increased genetic hazard over that from irradiation of the adult testis. In fact, as the data stand in the mouse, they indicate a mutation rate similar to the adult for all but the earlier stages tested and, for these stages, a probably lower rate, representing a transition from the significantly lower rate reported earlier for newborns. (auth)

8475 X-RAY-INDUCED SPECIFIC-LOCUS MUTATION RATE IN NEWBORN MALE MICE. Selby, P. B. (Univ. of Tennessee, Oak Ridge). Mutat. Res.; 18: No. 1, 63-75(Apr 1973).

The specific-locus mutation frequency resulting from 300 R of acute x irradiation was determined for the germ cells present in newborn male mice. The frequency is 13.7×10^{-8} mutations/locus/R, which is statistically significantly lower than that of 29.1×10^{-8} mutations/locus/R found earlier for the same loci in spermatogonia of the adult male by W. L. Russell. The mutation rate for newborn males does not differ significantly from the induced specific-locus frequency reported for fetal males by T. C. Carter et al. The incidence of clusters of specific-locus mutations found following the irradiation of the newborn males was statistically significantly higher than the cluster incidence reported by W. L. Russell for similar irradiation of adult males. This presumably indicates the survival of relatively fewer reproductive cells following irradiation of the day-0 testis. Although there are suggestions that the distribution of mutations among the loci following irradiation of the newborn males may be different from that of the irradiated adults, no statistically significant differences are demonstrated. It is quite possible that the testis of the newborn mouse may be comparable to the relatively undifferentiated human testis that persists for approximately 10 years. Until the present research was undertaken, no attempt has been made to determine the specific-locus mutation frequency resulting from x irradiation of newborn male mice. Although some important questions still remain concerning the explanation for the lower mutational response of the newborn mouse testis, from the hazard standpoint it is reassuring that the mutation frequency of the newborn male is statistically significantly lower than that of the adult. (auth)

Invertebrates

8476 USE OF RADIATION FOR PEST CONTROL. Kwon, S. H.; Jeong, K. H. J. Korean Nucl. Soc.; 5: No. 1, 65-71(Mar 1973). (In Korean).

8477 SUPPRESSION OF THE REPRODUCTIVE POTENTIAL OF A WILD STRAIN MEDITERRANEAN FRUIT FLY BY GAMMA IRRADIATED MALES IN CAGED COFFEE TREES. Katiyar, K. P.; Ramirez, E. (IICA, Turrialba, Costa Rica). Contract AT(11-1)-3217. Turrialba; 22: No. 2, 156-159(1972). (COO-3217-02).

Studies were made in the field in screen cages (3.6 m × 3.6 m × 2.4 m) erected over coffee trees bearing fruits at IICA-CTEI, Turrialba, Costa Rica, during 1968 and 1969 to determine the mating competitiveness of irradiated (7–10 kr) laboratory flies with untreated wild strain medflies. Sterile flies obtained by irradiating mature pupae (1–2 days before adult eclosion) were released unsexed. Untreated wild strain flies were collected as pupae from infested tropical almond fruits. Egg-hatch of mixed populations of sterile and normal flies was studied at 20:1, 40:1, 80:1, and 120:1 ratios for 12 to 17 weeks. Oviposition of female medflies in the coffee berries was poor and erratic in both tests. Based on mean egg hatch data, the mating competitiveness of irradiated males with normal males was reduced to approximately $\frac{1}{6}$ th to $\frac{1}{5}$ th in a mixed population of sterile and fertile flies up to an 80:1 ratio (sterile:normal). Releases of sterile and normal flies in the ratio of 120:1 was most effective in suppressing the reproductive potential of normal flies. Such a mixed fly population oviposited an average of 1.0 percent viable eggs over a 17-week period. (auth)

8478 SENSITIVITY OF SCALE INSECTS TO ^{14}C β-PARTICLES AND TO ^{60}Co γ-RAYS. Robertson, G. (Adelaide Univ., Glen Osmond, Australia). Int. J. Radiat. Biol.; 23: No. 4, 313-323(Apr 1973).

The concentrations of ^{14}C that can be tolerated by the scale insect Aonidiella aurantii (Mask) throughout its development were investigated. Dose-survival curves are presented, showing the activity of ^{14}C in insects in relation to the survival of first instar larvae, the emergence of winged males, and the reproduction of females. The 50% survival values, in terms of the concentrations of ^{14}C in the insects at these stages, were about 680 μCi gm^{-1}, 360 μCi gm^{-1}, and 24 μCi gm^{-1}, respectively. Calculations of the equivalent dose-rates from β particles are attempted. The sensitivity to ^{60}Co γ rays of insects of various ages was studied. Dose-survival curves showed that irradiation prior to moulting is about three times as effective as irradiation during moulting, and that irradiation at an early age has an effect on later development. These findings were used in calculating the cumulative doses from ^{14}C. At the 50% survival level, the cumulative dose from ^{14}C, adjusted for changes in sensitivity with time, was estimated to be about 7600 rads for first instar larvae, 9800 rads for emerging males, and 4200 rads for reproduction in females. These values are about three times the minimum γ-ray doses that produced similar effects. (auth)

8479 EFFECT OF AUTOGAMY ON THE SENSITIVITY OF CELLS TO NATURAL IONIZING RADIATIONS. Croute, F.; Soleilhavoup, J. P.; Planel, H. (Univ., Toulouse). Compt. Rend. Soc. Biol.; 166: No. 6, 948-951(1972). (In French).

The following difficulties may be encountered when using post-autogamous Paramecium aurelia cultures in radiobiology: the autogamy is accompanied by a considerable number of alterations in the radiosensitivity of the cells considered; the effect of natural ionizing radiations on the sensitivity disappears or even becomes negative; the radioprotection may involve a transient activation effect. (France)

8480 EFFECTS OF GAMMA RADIATION ON THE FERTILITY OF THE SPIDER MITE TETRANYCHUS ARABICUS ATTIAH. Wakid, A. M.; Elbadry, E. A.; Elaal, M. A. (Ain Shams Univ., Cairo). Ann. Zool.-Ecol. Anim.; 4: No. 3, 375-378(1972).

Male and female Tetranychus arabicus Attiah were sterilized with doses of 28 and 30 Krads respectively. The fecundity of treated females mated with untreated males was modified by doses of 24 and 30 Krads. The viability of the eggs produced by treated mites was modified by doses of 16 and 30 Krads. Doses ranging from 8 to 60 Krads induced dominant lethal mutations in the sperms. Doses of 80, 100, and 140 Krads caused sperm injury or inactivation. Females mated with gamma-irradiated males produced fewer female offspring and more nonviable eggs as the radiation dose increased. A dose of 28 Krads produced only male offspring. (France)

8481 EFFECTS OF GAMMA RADIATION ON THE SPIDER MITE TETRANYCHUS ARABICUS ATTIAH. Wakid, A. M.; Elbadry, E. A.; Elaal, M. A. (Ain Shams Univ., Cairo). Ann. Zool.-Ecol. Anim.; 4: No. 3, 379-383(1972).

The effects of 5 to 60 Krad doses of ^{60}Co γ radiation on newly hatched Tetranychus arabicus larvae were studied. The mortality rate was found to be higher for larvae and nymphs developing from the irradiated newly hatched larvae. A significant delay in post-embryonic growth was observed. A decreasing fecundity with increasing dose was also observed. The females did not deposit eggs when the dose reached 30 Krad. The females descending from the irradiated larvae produced few offspring and more nonviable eggs. A dose of 15 Krad reduced the viability of the eggs to 25%. The lifetimes of the adults was reduced. This reduction was appreciable with a 10 Krad dose. A 25 Krads dose completely inhibited the development of males. (France)

8482 NUCLEAR-CYTOPLASMIC RELATIONS IN THE MITOSIS OF SEA URCHIN EGGS. IV. Modification of γ Radiation-Induced Damage to Sperm in Whole Eggs and in Haploid and Diploid Half-Eggs. Rustad, R. C. (Case Western Reserve Univ., Cleveland). Radiat. Res.; 54: No. 2, 328-332(May 1973).

The sensitivity of postfertilization mitotic delay arising from γ-radiation damage to sperm is enhanced by reducing the cytoplasmic volume of diploid eggs and reduced by removing the female pronucleus of half-sized eggs. These results can be explained if one assumes that these are repair processes that exhibit a rate dependence on cytoplasmic volume and act for a longer time in haploid eggs, which have a longer postfertilization mitotic cycle than diploid ones. This recovery hypothesis is consistent with other data suggesting a role of protein synthesis in the repair of the damage by γ-radiation that leads to mitotic delay. (auth)

8483 RADIATION EFFECTS ON THE HEMOLYMPH FREE AMINO ACID POOL OF THE HONEYBEE PREPUPA (APIS MELLIFERA) AND THE WAXMOTH LARVA (GALLERIA MELLONELLA). Richardson, B. L.; Myser, W. C. (Ohio State Univ., Columbus). Radiat. Res.; 54: No. 2, 274-283(May 1973).

Honeybee prepupae (Apis mellifera) were exposed to 50 kR of x rays and hemolymph samples collected 1 hour postirradiation. Last-instar wax moth larvae (Galleria mellonella) were exposed to 5, 10, 20, 50, and 75 kR of x rays and hemolymph samples collected 24 hours postirradiation. Hemolymph extracted from honeybee prepupae 1 hour after a 50-kR exposure showed increased concentrations of phosphoethanolamine and valine. The predominant radiation effect on the hemolymph from wax moth larvae was an increased concentration of both individual amino acids and the total pool. The lowest exposure at which a radiation effect could be

demonstrated was 10 kR, at which exposure lysine increased in concentration. The total pool showed significant increases at exposures greater than 20 kR. The increased free amino acid concentration after x-irradiation was attributed to a decreased capacity of the tissues to utilize the free amino acid pool particularly with respect to protein synthesis. (auth)

8484 MEIOTIC BEHAVIOR OF ASYMMETRIC DYADS IN THE MALE DROSOPHILA. Zimmering, S.; Bendbow, E. B. (Brown Univ., Providence). Genetics; 73: No. 4, 631-638(Apr 1973).

Crossing over in the interstitial region of the heterozygous V_4 translocation in Drosophila melanogaster generates asymmetric dyads each consisting of a shorter and a longer chromatid. It was shown previously that in the female the shorter is recovered preferentially; the present work suggests that the same occurs in the male as well. The mechanism in the female is envisioned as involving the non-random inclusion of the shorter chromatid into the functional egg; in the male, the two formal possibilities appear to be that some proportion of sperm carrying the longer chromatid derived from an asymmetric dyad undergoes dysfunction, or the longer chromatid is preferentially included into regularly-produced nonfunctional sperm, the nonfunctionality set up at the second division and distinguishing second division daughter cells. (auth)

8485 CYTOLOGICAL ANALYSIS OF CROSSOVERS INDUCED BY IRRADIATION IN DROSOPHILA MELANOGASTER FEMALES. Mglinets, V. A. (Research Inst. of Medical Radiology, Obninsk, USSR). Genetika; 9: No. 3, 69-75(Mar 1973). (In Russian).

Crossovers were induced by gamma-irradiation of Drosophila melanogaster females homozygous for c(3)G and heterozygous for various marker genes. It was found that among 149 induced crossovers 11 were associated with chromosome rearrangements (3 inversions and 8 duplications). Among 317 irradiated nonrecombinant chromosomes 8 chromosome rearrangements (6 inversions and 2 duplications) were found. Most of the chromosome rearrangements were found in broods corresponding to stage 14 and stage 7 oocytes. The points of induced exchange coincided with that of chromosome breaks thus indicating that cause and effect relation might exist between chromosome rearrangements and induced crossing-over. (auth)

8486 EFFECTS ON FECUNDITY AND FERTILITY OF SINGLE SUBLETHAL X IRRADIATION OF GAMMARUS DUEBENI FEMALES. Hoppenheit, M. (Laboratorium Suelldorf, Hamburg). pp 479-486 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Research into environmental protection is not so much concerned with the fate of individual as with populations and, therefore, it is important to study those effects which operate at population level. Fifty female gammarids (Crustacea, Amphipoda) were each x irradiated with sub-lethal doses of 740, 490, 330, 220, 147, 98, and 65 R. Production of eggs and young was checked and the rate was calculated. Reduced egg production rate can be established at doses down to 220 R; this is caused both by reduced brood size and omitted ovipositions. Differences are found between the number of eggs laid and the number of young discharged from the broad-chamber at doses down to 490 R. After irradiation with 147 R or less no effect on fecundity or fertility is observable. Irradiation doses of 220 R and lower have a so-called beneficial effect distinguishable by the irradiated specimens' higher survival rate, whereby the lower egg production rate is more than compensated by the higher number of live females and the resulting increased production of young. (auth)

8487 EFFECTS OF CONTINUOUS LOW-LEVEL γ RADIATION ON SESSILE MARINE INVERTEBRATES. Williams, R. B.; Murdoch, M. B. (National Marine Fisheries Service, Beaufort, NC). pp 551-563 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Effects of chronic low-level γ irradiation were examined on six species, sponge (Hymenacidon heliophila), coral (Astrangia danae), oyster (Crassostrea virginica), slipper shell (Crepidula fornicate), barnacle (Balanus sp.) and ascidian (Molgula manhattensis). Organisms were maintained in running seawater and irradiated with a ^{60}Co γ source at least 94.3% of the time for periods of approximately 3 to 7 months. Each species was exposed to each of 10 dose rates ranging from 0.0000085 to 21.2 rad/hr. Growth of new tissue by sponge colonies was reduced by irradiation as low as 0.85 rad/hr. Dose rates of 4.2 rad/hr damaged coral and slightly reduced growth and survival of oysters. Slipper shells grew well exposed to 8.5 rad/hr as did ascidians exposed to 1.7 rad/hr but there were no consistent radiation effects. Barnacles died from factors not associated with radiation, but one individual survived and grew slightly at 0.85 rad/hr. Respiration per gram live weight of sponge colonies was reduced at higher dose rates. (auth)

8488 STUDIES ON NON-DISJUNCTION OF THE MAJOR AUTOSOMES IN DROSOPHILA MELANOGASTER. I. Methodology and Rate of Induction by X Rays for the Compound Second Chromosome. Clark, A. M.; Sobels, F. H. (Univ., Leiden). Mutat. Res.; 18: No. 1, 47-61(Apr 1973).

The induction of non-disjunction by x irradiation of the second chromosome in stage-7 oocytes of Drosophila melanogaster was studied by employing isochromosome stocks. This makes the quantitative recovery possible of progeny resulting from disomic and nullosomic eggs. Determination of egg hatchability was used to correct for varying degrees of segregation in males carrying different isochromosomes. Even at exposures as low as 250 R, the frequency of non-disjunction is significantly higher than in the controls. No evidence was obtained for the existence of a threshold. In the stage-7 oocytes, the induction of non-disjunction increased linearly with radiation exposure over a range of 250 to 3000 R and thus seems to reflect a single-hit event. These findings could be of significance for the evaluation of genetic radiation hazards in man. In slightly younger oocyte stages the induction of disomic eggs followed dose-square kinetics. The frequency of nullosomic eggs rises exponentially with radiation exposure, presumably as a consequence of increasing chromosome loss resulting from unrestituted breaks in each of the two maternal isochromosomes. Furthermore, it was observed that the late stage-7 oocytes were more sensitive to the induction of non-disjunction than earlier stages. (auth)

8489 OBSERVATIONS CONCERNING THE EFFECTS OF RADIATIONS ON THE SEGREGATION OF CHROMOSOMES. Parker, D. R.; Busby, N. (Univ. of California, Riverside). Mutat. Res.; 18: No. 1, 33-46(Apr 1973).

Nondisjunction of X and of fourth chromosomes was observed following the exposure of immature oocytes of Drosophila melanogaster to doses of x radiation of from 1000 to 4000 R. No evidence for a threshold was found in this range for either kind of trisomy; this evidence alone does not exclude the possibility that one might be found at some lower dose. The mating of the treated females with males having an attached-XY chromosome permitted the recovery of fertile males that would otherwise have been XO and sterile. Testing of these showed some 22% to be triplo-4, having two maternal fourth chromosomes. Marking the left arm of chromosome 4 with a small duplication made it possible to score marker losses such as might result from interchange with another acrocentric (e.g., the X). There is a high coincidence of marker loss from chromosome 4 and both the XO and triplo-4 conditions, with the highest incidence of marker loss being when these have occurred together. The interpretation that the altered 4's are half-translocations resulting from X-4 interchange is further supported by the finding that they also show altered assortative behavior in compound-X females lacking a Y, when in combination with a standard fourth chromosome. A few show regular segregation from the attached-XY in the male, supporting the interpretation that they have the base of the X capped by the right arm of chromosome 4. It is argued that other trisomies may come about by mechanisms similar to that responsible for the triplo-4 condition. Furthermore, if rearrangement plays a part in the origin of trisomy, operating by altering division-I orientation as a result of heterologous conjunction maintained by chromatid interchange, it is unlikely that there will be a threshold for its induction. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 8175, 8176, 8402, 8426, 8532, and 9888.

8490 (KFK-1638, pp 245-250) RADIATION PROTECTION PROBLEMS DURING HANDLING OF HIGH-ACTIVITY TRITIUM TARGETS. Beyer, D.; Friedrich, W.; Knieper, J.; Sauermann, P. F. (Kernforschungsanlage, Juelich, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

During changing of a high-activity tritium target of a fast neutron generator, measurements of surface and air contamination and of incorporation were performed. The results indicate that risks from contamination and incorporation during target change

and handling of non-irradiated targets must not be underestimated. Due attention being paid to the necessary protective measures, however, hazards of the operating personnel can be avoided. (GE)

8491 KFK-1638, pp 253-257) EVALUATION OF THE LUNG BURDEN RESULTING FROM INHALATION OF PuO_2 WITH THE HELP OF SEPARATION ANALYSES. Schieferdecker, H.; Polig, E. (Kernforschungszentrum, Karlsruhe, Ger.). May 1972. (In German).

From 6th annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

In February 1972, a laboratory technician inadvertently handled 3 mg PuO_2 outside the glove box. During the first six days, he excreted about 1 nCi activity in the stool. The new lung model of the ICRP was used for assessing the pulmonary burden. Under the assumption of a clearance from the pulmonary compartment into the gastrointestinal tract, the dose burden was assessed. For the presented case, an activity of about 1.6 nCi was derived as the amount deposited in the lungs. (HBG)

8492 (RD/B/N-2507) DEVELOPMENTS IN THE RADIATION DOSIMETRY OF BONE SEEKING RADIONUCLIDES WITH SPECIAL REFERENCE TO ^{89}Sr AND ^{90}Sr. Darley, P. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

The recent development of improved dosimetric models for the bone-seeking radionuclides has made possible the derivation of Maximum Permissible Body Burdens and related levels based on dose limits to the critical soft tissues of bone. This approach avoids the necessity of relying on the somewhat arbitrary formalized comparison with the empirically founded maximum permissible body burden for ^{226}Ra, used at present, and brings the bone seekers into line with ICRP practice for other internally deposited radionuclides. The models that will form the basis of future ICRP recommendations are reviewed and the effects of their adoption on the levels accepted for use by the CEGB are outlined and discussed. (auth)

8493 BIOLOGICAL RADIATION EFFECTS IN THE INCORPORATION OF INTERMEDIATE MASS NUCLEI INTO TISSUES AND APPLICATION TO SOFT X RAYS. Tisljar-Lentulis, G.; Feinendegen, L. E. (Kernforschungsanlage, Juelich, Ger.). (1972). vp. (In German).

From Meeting: nuclear medicine and radiochemistry; Freiburg i. B., Germany (27 Sep 1972).

The biological effects in labeled mammalian cells of incorporated radioisotopes emitting Auger electrons are 7 to 10 times stronger than could be expected from the energy deposition of the radiation. This is due to the high fraction of extremely low energetic electrons with relatively high values of energy loss, and the decomposition of molecules labeled with Auger emitters (several times multiply positively charged after radionuclide decay). An increased utilization of the Auger emissions in biological and therapeutical procedures is achieved by inducing Auger cascades by producing voids in the inner electron shells of certain atoms by x rays. The strong absorption of the most suitable ultrasoft x radiation in the tissues is avoided by incorporating heavier atoms into the tissue and applying higher x-ray energies (10 to 40 keV) with greater effectiveness corresponding to the K-absorption discontinuity of these atoms, calculated for Cr up to Nd; half-value thickness in the tissue 0.1 to 3 cm; photo-effective cross sections 10^4 to 10^5 b/atom. The nuclides (Br, I, and Br^-, I-desoxyuridine) can be either injected into the tissue to be irradiated, or else incorporated indirectly into the DNA of living cells. Experimental parameters, local radiation effect, dose values, and energy deposition are discussed and Merit factors (in cm) vs. atomic numbers are shown in a table. (GF)

8494 LATE EFFECTS ON BONE MARROW AFTER INTRAVASAL APPLICATION OF THOROTRAST. van Kaick, G. (Deutsches Krebsforschungszentrum, Heidelberg); Drings, P. (1972). vp. (In German).

From 10th annual meeting of the Society for Nuclear Medicine; Freiburg i. B., Germany (27 Sep 1972).

A case of chronic-myeloid leukemia is discussed, the only case to be found among a number of 700 Thorotrast patients. Another person from this group of patients investigated about 3 yrs ago has died in the meantime of acute promyelocyte leukemia. A late anamnesis of 900 patients who died later than 3 yrs after the first administration of Thorotrast revealed several cases of leukemia and other hemic diseases. The authors discuss the question as to whether there is a connection between the administration of Thorotrast and myelopathy. The latency periods of the cases of leukemia under investigation range from 2 to 33 yrs. The existence of a relationship between absorbed dose and latency period that could be verified by mathematical methods seems very unlikely. The calculation of the maximum radiation dose has to take into account above all those patients who have most been exposed and consequently run the greatest risk. To develop appropriate ways and means to identify these patients is one of the plans currently pursued by epidemiologists. (GF)

8495 DISTRIBUTION AND RADIATION DOSIMETRY OF $^{109}Cd-^{109m}Ag$ TO BE APPLIED IN NUCLEAR MEDICINE. Roedler, H. D.; Glaubitt, D.; Marx, E.; Marx, R.; Schaefer, H.; Glatthor, M. (Freie Univ., Berlin). (1972). vp. (In German).

From 10th annual meeting of the Society for Nuclear Medicine; Freiburg i. B., Germany (27 Sep 1972).

Applying the results of experimental studies in rats to man it can be concluded that ^{109}Cd is likely to cause a significant radiation dose to kidneys and liver if incorporated into the body in larger amounts. This possibility arises in the case of a nuclear medical visualization of blood vessels and organs using ^{109m}Ag, if the optimal conditions of elution of ^{109m}Ag from an ion exchanger, containing ^{109}Cd, are not strictly observed. (GF)

8496 MEAN ABSORBED DOSES IN TRANSPORT WORKERS IN ITALY IN 1969 AND 1970. Roberti, M.; Roselli, A.; Susanna, A. (CNEN, Rome). Minerva Fisiconucl.; 16: No. 1, 31-46 (1972). (In Italian). (RT/PROT(72)33).

Comparison between mean absorbed doses in transport workers in Italy in the periods 1967 to 1968 and 1969 to 1970 showed a gradual decrease in values due to an increase in the number of journeys and carriers and a decrease in the transport index per package. To obtain a more complete picture, a statistical inquiry was undertaken to determine the distributional frequency of isotopes commonly employed for therapeutic, diagnostic, industrial, and research purposes. For this purpose, package activity, transport index, type of packing and category data were examined. The main aim of the study was the identification of problems related to the protection of persons engaged in the transport of radioactive materials. (auth)

8497 ASSESSMENT OF CONTENT OF CONCENTRATED AND NATURAL URANIUM IN THE BODY AND CRITICAL ORGANS. Andreeva, O. S.; Egorova, M. S. Gig. Sanit.; No. 3, 53-58(Mar 1973). (In Russian).

Assessment of the uranium content in the body of workers and comparison of the data obtained with the permissible standard levels may serve as reliable criteria of hygienic labor conditions and bases for organizing necessary preventive measures. (auth)

8498 SIMPLIFIED INTERNAL DOSIMETRY METHOD. Conte, L.; Mombelli, L. (Univ., Milan). Radiol. Med.; 58: No. 12, 992-1005(Dec 1972). (In Italian).

A simplified method for whole body and critical organ dosimetry in diagnosis with internally administered unsealed isotopes is described. Physical errors are slightly increased by the adoption of mean absorbed fraction values over wider energy intervals. On the other hand, biological errors are substantially reduced, since the method facilitates the individual appraisal of size and function. (auth)

8499 PREVENTIVE AND PROTECTIVE MEASURES IN WORK WITH TRANSPLUTONIUM ELEMENTS. Parkhomenko, G. M.; Egorova, M. S.; Kopaev, V. V. Gig. Sanit.; No. 4, 43-46(Apr 1973). (In Russian).

The determination of the possible factors of the transplutonium elements action on the personnel, the systematic sanitary dosimetric control at the time of fulfilment of radiation hazard works, and a scientific substantiation of effective protective measures make it possible to create a stable basis in provision of safe labor conditions. (auth)

Animals

Refer also to abstracts 8184, 8462, and 8478.

8500 AUTORADIOGRAPHIC FINDINGS IN RADIATION INJURY. Studies on Embryonal Intestinal Tracts. Wegner, G. (Robert-Bosch-Krankenhauses, Stuttgart). Bruns Beitr. Klin. Chir.; 219: No. 4, 367-373(1972). (In German).

DNA-synthesis and mitosis incidence in the intestinal tract were investigated by autoradiographic means during the undisturbed embryo-fetal development in the rat and also after irradiation (150 R) of the pregnant rat. High numbers of DNA synthesizing cells and high mitosis rates were to be found during the formation of the primitive foregut. During the further development of the small intestine, the labeling indices were not subjected to any gross fluctuations and they showed average values. (auth)

Microorganisms

8501 DNA STRAND BREAKS FROM TRITIUM DECAY. A Local Effect for Cytosine-6-^{3}H. Krasin, F.; Person, S.; Snipes, W. (Pennsylvania State Univ., University Park). Int. J. Radiat. Biol.; 23: No. 4, 417-420(Apr 1973).

Sedimentation techniques were used to study the strand breakage in Escherichia coli produced by tritium decay in labeled cytosine incorporated into the DNA. It was shown that the decay of cytosine-6-^{3}H was four times as efficient in producing single-strand breaks as was the decay of cytosine-5-^{3}H. It is suggested that, although cytosine-5-^{3}H is more mutagenic, cytosine-6-^{3}H may be more lethal in a biological system where the integrity of the individual DNA strands is essential. (UK)

8502 ENRICHMENT FOR TEMPERATURE-SENSITIVE AND AUXOTROPHIC MUTANTS IN SACCHAROMYCES CEREVISIAE BY TRITIUM SUICIDE. Littlewood, B. S.; Davies, J. E. (Univ. of Wisconsin, Madison). Mutat. Res.; 17: No. 3, 315-322(Mar 1973).

Tritium suicide is shown to be an efficient technique for mutant enrichment in Saccharomyces cerevisiae. Decays from incorporated [5-^{3}H] uridine and tritiated amino acids proved equally effective in inducing suicide; in cultures labeled to a specific activity of 50 dpm/cell, the viability fell to 2% after 12 days' storage at 4°. Mutagenized cultures were labeled with either [5-^{3}H] uridine or a mixture of tritiated amino acids under conditions where auxotrophic mutants and temperature-sensitive mutants in RNA or protein synthesis would not incorporate a significant amount of the tritiated precursor. When survival fell to 2%, the percentages of both auxotrophic and temperature-sensitive mutants were 10-fold higher among these survivors than in the original mutagenized culture, regardless of the radioactive precursor used. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstract 8141.

Man

Refer also to abstracts 8150, 8431, 8491, and 8532.

8503 (EUR-4964) IODINE METABOLISM IN CHILDREN AND ADOLESCENTS IN A REGION OF THE EEC. Karhausen, L.; Pages, J. P.; Vacca, G.; Piepz, A.; De Visscher, M. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar 1973. 123p. (In French). Dep. NTIS (U. S. Sales Only) $8.25. EUR FB 165,-.

Work is being carried out to draw up a model for European thyroid function during growth and to determine the consequences from the point of view of radiological protection. Kinetic studies using iodine-131 and iodine-125 were carried out on 46 young babies and 47 adolescents. A three-compartment model is presented for age 0 to 6 months, 6 months to one year, one year to two years, and for adolescents and adults. The ICRP parameters were calculated for the various age categories. (auth)

8504 IMPORTANCE OF KINETIC STUDIES AND MODEL CONCEPTS FOR THE APPLICATION OF RADIOACTIVE ISOTOPES. Koblet, H. (Univ., Zurich). (1972). vp. (In German).

From 10th annual meeting of the Society for Nuclear Medicine; Freiburg i. B., Germany (27 Sep 1972).

When discussing kinetic analyses and model concepts of complicated compartment systems, one has to proceed from the following considerations: the basic ideas are universal; and although the measured values are quite exact, they often yield but little information and call for an appropriate interpretation. This is done by means of model concepts. Models, however, are not exact by definition. In multi-compartment models for instance, the measuring values of the accessible compartment to be analyzed are subject to the influence of non-accessible adjacent compartments whose number and volume is difficult to determine. Hence it must be said that the calculated parameters according to the catalogue of statements that has been set up are to be considered as somewhat uncertain. This is why the author suggests to use only simple models for diagnostic comparative studies in clinical medicine, as these models are more likely to yield useful comparative parameters without any claim to scientific completeness or perfection. (GE)

8505 KINETICS OF UPTAKE AND CLEARANCE OF ^{99m}Tc AND ^{131}I IN THE THYROID. A Comparative Study. Pfeifer, K. J.; Ingrisch, H.; Rothe, R.; Souvatzoglou, J.; Heinze, H. G. (Univ., Munich). (1972). vp. (In German).

From 10th annual meeting of the Society for Nuclear Medicine; Freiburg i. B., Germany (27 Sep 1972).

After injection of 1 to 2 mCi of ^{99m}Tc-pertechnetate or 150 μCi of ^{131}I, a rapid influx of both compounds was observed during the first 5 min. Subsequently the curve of accumulation of ^{99m}Tc was much flatter than that of ^{131}I. In 55%, a slope was found even within the time of investigation. (GF)

8506 LEAD-210 CONCENTRATIONS IN THE BONE, BLOOD, AND EXCRETA OF A FORMER URANIUM MINER. Cohen, N.; Jaakkola, T.; Wrenn, M. E. (New York Univ.). Health Phys.; 24: No. 6, 601-609(Jun 1973).

Measurement of ^{210}Pb in the skull of a former uranium miner was accomplished by in vivo thin crystal counting techniques performed on each of five consecutive days. From these results it was estimated that the total skeletal burden for this individual (Cumulative Working Level Month ≃6900) is in the range of 5.6 to 7.3 nCi of ^{210}Pb. The calibration factor for ^{210}Pb in the human skull was experimentally measured as 10.0 counts/min/nCi. Using this efficiency and the background counts for several control subjects, the minimum significant measurable activity for the head is 0.13 nCi, corresponding to a total skeletal burden of 0.87 nCi of ^{210}Pb. In addition to in vivo scintillation analysis, samples of urine, feces, blood, and diet were assayed for ^{210}Pb content to determine the relationship between the skeletal burden and the daily fractional excretion rate. The average daily urinary excretion of ^{210}Pb was 1.91 and 0.24 pCi for the uranium miner and four control subjects respectively. The average excretion of ^{210}Pb in feces for the uranium miner and four control subjects was 0.053 and 0.054 pCi/g of dry weight respectively. Lead-210 intake from food consumed during the measurement week was 1.8 pCi/day. Using these results, it was estimated that from 1.2 to 1.7 pCi of ^{210}Pb are excreted daily as a result of the skeletal burden acquired from prior exposures to uranium mine atmospheres. Calculations using these values gave estimates of the biological half-time for ^{210}Pb in bone of from 6.4 to 11.9 yr. (auth)

8507 TRITIUM [URINE ANALYSIS FOLLOWING EXPOSURE]. Wylie, K. F. (Univ. of Mississippi, University). Health Phys.; 24: No. 6, 683(Jun 1973).

The possibility of a multiple compartment model to describe the biological half-life of tritium in the human body is discussed with reference to work by Moghissi et al. (Health Phys.; 21: 57(1971)) and Snyder et al. (Phys. Med. Biol.; 13: 547(1968)). A discontinuity apparently occurred in these analyses at between 190 and 290 days after exposure and at approximately 240 days after exposure respectively. The results of a re-examination of urine analyses following accidentally ingested and/or inhaled tritium by two males are given. These suggest a possible retention of tritium and/or continued exposure and retention at low concentrations and also show a discontinuity occurring at approximately 30 days before that observed by Snyder et al., which could be attributable to self-imposed forced intakes of substantial quantities of fluids. (UK)

8508 DISTRIBUTION OF RADIONUCLIDES IN REEF CORALS: OPPORTUNITY FOR DATA RETRIEVAL AND STUDY OF EFFECTS. Knutson, D. W.; Buddemeier, R. W. (Univ. of Hawaii, Honolulu). pp 735-746 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Autoradiography of sectioned massive corals from Eniwetok revealed the presence of discrete bands of radioactivity identifiable with specific nuclear test series. X-radiographs of these and other corals show structural density variations which comparison with the autoradiography demonstrates to be seasonal in nature. The coral structure thus contains a reasonably reliable internal calendar. Residual ^{90}Sr activities were determined for the Eniwetok corals, and a Fanning Island coral was used to reconstruct the uptake of excess ^{14}C at that location. In addition to permitting retrieval of past radionuclide concentrations as sampled by the corals, the method permits retrospective study of the organism's structural response to incorporation of the radioactivity. Results to date indicate that the macroscopic growth-rates and patterns of these corals are relatively unaffected by uptake of the observed amounts of radioactivity, and that reef corals can provide a valuable record of past variations in the marine concentrations and distributions of various radionuclides. (auth)

8509 ^{90}Sr ACCUMULATION IN A DEVELOPING EMBRYO. Borisov, B. K. Gig. Sanit.; No. 4, 49-52(Apr 1973). (In Russian).

In the case of continuous entry of ^{90}Sr into the body of a pregnant mother, the isotope is detected in the skeleton of a newborn child at concentrations that are 2.3 fold higher than its contents in a daily food ration. This value amounts at an average to 1.3% of the total amount of ^{90}Sr that entered the mother's body in the last 7 months of pregnancy, i. e. since the moment the embryo skeleton formation started. (auth)

Animals

Refer also to abstracts 8142, 8170–8174, 8185, 8199, and 8495.

8510 EXPERIMENTAL INVESTIGATION OF THE KINETICS OF RADIOTECHNETIUM; RADIOINDIUM; AND RADIOGALLIUM. Hoer, G.; Kriegel, H.; Heidenreich, P.; Schramm, E. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). (1972). vp. (In German).

From 10th annual meeting of the Society for Nuclear Medicine; Freiburg i. B., Germany (27 Sep 1972).

The kinetic behavior of ^{99m}Tc, ^{113m}In, and ^{67}Ga was investigated in lactating rats and in young rats after stimulation of the drinking avidity. Non-lactating rats of the same age were used as controls. Following the injection of the radionuclides into the rats, the young animals were allowed to suck for 3, 6, 18, and 24 hrs and the activity concentration was determined. The results show that almost no radioindium, but considerable quantities of radiotechnetium and even large quantities of radiogallium are transferred to the sucking young rats via the milk. The different biological behavior of ^{67}Ga in the femur of lactating and non-lactating rats clearly demonstrates the decorporation effect of the lactation. Hence there is a clear contra-indication of the application of ^{67}Ga in the early lactation period. (GE)

8511 EFFECT OF NUCLEAR FISSION PRODUCTS ON IMMUNOLOGICAL REACTIONS. Shubik, V. M.; Nevstru'eva, M. A.; Livshits, R. E.; Kolotvin, V. A. (Leningrad Scientific Research Inst. of Radiation Hygiene). Zh. Mikrobiol., Epidemiol. Immunobiol.; No. 9, 12-17(1972). (In Russian).

Rats were injected once with an undivided mixture of rare earth (^{140}La, ^{141}Ce, ^{144}Ce, ^{143}Pr, ^{91}Y, ^{147}Nd) and alkali earth (^{89}Sr, ^{140}Ba) radionuclides to determine the effect of these nuclear fission products on nonspecific (Ioffe's test, bactericidal action, lysozyme, complement serving as criteria) and specific (antibody response to inoculation of Proteus vulgaris and sheep erythrocytes) immunity. Nonspecific reactions and antibody formation were depressed and a large quantity of autoantibodies to liver and kidney tissues were produced. These changes were phaselike: periods of decrease alternated with phases of normalization and even stimulation. There was a distinct relationship between most of the immunological parameters and the dose of radioisotopes used. The various factors differed in sensitivity to internal irradiation. (JPRS)

8512 ACCUMULATION FROM WATER OF ^{65}Zn, ^{54}Mn, ^{58}Co, AND ^{59}Fe BY THE MUSSEL, MYTILUS EDULIS. Pentreath, R. J. (Ministry of Agriculture, Fisheries and Food, Lowestoft, Eng.). J. Mar. Biol. Ass. U.K.; 53: No. 1, 127-143(Feb 1973).

The accumulation from seawater of ^{65}Zn, ^{54}Mn, ^{59}Fe, and ^{58}Co by the mussel, Mytilus edulis, has been studied in relation to the stable element levels of these isotopes both in the seawater and in individual tissues. For all four radionuclides, the greatest accumulation occurred in the stomach and digestive gland samples and further localization of ^{65}Zn and ^{59}Fe was demonstrated by autoradiography. As the animals were starved during the accumulation period the loss of stable elements by individual tissues was also followed. Again the most notable effect occurred in the digestive gland tissues with the exception of a large loss of iron by the foot. Autoradiography showed that after two weeks accumulation ^{59}Fe occurs in large clusters in the foot, notable in the byssus gland area. These clusters disappear after a further two week period and may thus be secreted into new byssus threads. The accumulation of nuclides was examined using a single exponential model and values obtained for flux rates, biological half times, and asymptotic values were compared with the stable element concentration factors. An analysis of parameters of exchange of nuclides in individual tissues with the water was further examined using the Kendall coefficient of concordance that demonstrated that the highest exchange occurs in the order of stomach and digestive gland > gill > foot > mantle gonad > adductor. (auth)

8513 RETENTION OF ^{241}Am BY SOME ENDOCRINE ORGANS OF THE RAT AND ITS RESPONSE TO DPTA-TREATMENT. Seidel, A. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 23: No. 4, 415-416(Apr 1973).

A brief note is made of experiments to investigate the retention of ^{241}Am by the thyroid, ovaries, and adrenals of the rat, as influenced by treatment with Ca-DTPA or Zn-DTPA (30 μmole Kg^{-1} body weight), after intervals of up to 81 days. No significant elimination was observed in control animals after the 15th day. Concentrations (per cent of the ^{241}Am-dose g^{-1} fresh weight) on the 78th day were 0.029 ± 0.003, 0.041 ± 0.002, and 0.048 ± 0.004 for thyroid, adrenals, and ovaries respectively. Both chelates were equally effective in reducing the ^{241}Am-content of the organs (as low as 8% of the control in the thyroid, and 17% in the ovaries), their effectiveness depending on the time of administration. It is suggested that taking into account the length of the residence time and the possibility of non-uniform distribution, ^{241}Am deposition in the endocrine organs might be of some importance. (UK)

8514 RELATIONSHIPS BETWEEN NEBULIZER SUSPENSION CONCENTRATION, CONCENTRATION, AND SIZE DISTRIBUTION OF $^{239}PuO_2$ AEROSOLS GENERATED FOR ANIMAL INHALATION EXPERIMENTS. Craig, D. K.; Buschbom, R. L.; Herring, J. P. (Battelle Pacific Northwest Labs., Richland, WA). Health Phys.; 24: No. 6, 637-644(Jun 1973).

In a study of low-level effects of inhaled $^{239}PuO_2$ in beagle dogs, alveolar burdens over the 1500-fold range from 2 nCi to 3 μCi were deposited in unanesthetized dogs by aerosol inhalation. Aerosols were generated by nebulizing magnetically-stirred suspensions of $^{239}PuO_2$ particles in water, the aerosol concentration (CONC) being varied, primarily, by changing the Pu concentration of the suspension (SSA). If the mass concentration of the suspension was kept below about 10 mg (540 μCi) PuO_2/ml, a good correlation (R = 0.827 for n = 64) was observed between CONC and SSA with constant air flow through the exposure chamber. SSA values from 1 to 600 μCi/ml gave CONC values in the range 1.5 to about 3000 nCi/l. However, the aerodynamic equivalent size distribution of $^{239}PuO_2$ in the exposure chamber was found to vary significantly with CONC. The aerosols were log-normally distributed and the activity median aerodynamic diameter (AMAD) increased from about 1.5 to 3 μm as CONC increased (R = 0.777 for n = 64), while the geometric standard deviation (GSD) decreased (R = −0.576 vs AMAD). An explanation of this unexpected phenomenon, based on aggregate formation due to the greater likelihood of there being more than one PuO_2 particle per nebulizer droplet at the higher SSA values, is advanced. The effect is believed to contribute to the large variation observed in the percentage alveolar deposition of inhaled $^{239}PuO_2$ aerosols from 1.4 to 31.3% in 52 dogs for which the thorax x-ray count was significantly different from zero at P < 0.05. (auth)

8515 REDUCTION OF IODINE TRANSFER TO MILK OF COWS AFTER PERCHLORATE INGESTION. Lengemann, F. W. (Cornell Univ., Ithaca, NY). Contract AT(11-1)-3167. J. Dairy Sci.; 56: No. 6, 753-756(Jun 1973).

These experiments quantitate the relation between amount of perchlorate ingested and radioiodine transferred to milk of the cow when radioiodine is fed daily or after radioiodine administration ceases. When radioiodine was given daily, graded doses of perchlorate, from 10 to 4,000 mg/day, increased plasma iodine in accord with $Y = 88.1\ X^{.052}$. (Y = % of control value and X is the daily dose of perchlorate in milligrams.) Curves for iodine-125 in milk and ratio of milk to plasma iodine-125 between the limits of 50 and 1,000 mg perchlorate daily were fitted by $Y = 794.8\ X^{-.525}$ and $Y = 1{,}046.5\ X^{-.601}$; these same curves between 10 and 50 mg perchlorate daily were fitted by $Y = 85.6 + 0.37\ X$ and $Y = 82.3 + 0.28\ X$. Between 1,000 and 4,000 mg perchlorate, these curves had a slope of 0. These data indicate that perchlorate can inhibit the iodide-transfer mechanism of the mammary gland of the cow and that a ratio of milk to iodine of 0.2 indicates complete blockage of this transfer. Administration of 1 g of perchlorate daily leads to 55% less radioiodine being transferred to milk after administration of iodine-125 has ceased. (auth)

8516 COMPARISON OF THE EFFECTIVENESS OF CaDTPA AND ZnDTPA IN REMOVING ^{241}Am FROM THE RAT. Seidel, A. (Kernforschungszentrum, Karlsruhe, Ger.). Radiat. Res.; 54: No. 2, 304-315(May 1973).

The mobilization of internally deposited ^{241}Am by single doses of CaDTPA and ZnDTPA as dependent on time and dosage was studied. Notwithstanding the kind of chelate, their effect in the organs is sustained over several days and diminishes with increasing time interval between injection of ^{241}Am and chelate. The removal of ^{241}Am from the liver is markedly higher than from other organs. With early treatment, i.e., ≤24 hours after ^{241}Am injection, CaDTPA is slightly more effective than ZnDTPA, whereas there is no difference in efficacy in the case of delayed administration. The theoretical and practical implications of the results are discussed. (auth)

8517 INCORPORATION OF RADIOSTRONTIUM BY MARINE ORGANISMS. Cancio, D.; Llauro, J. A.; Ciallella, N. R.; Beninson, D. J. (Comision Nacional de Energia Atomica, Buenos Aires). pp 347-357 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973). (In Spanish).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

The discrimination factors for strontium and calcium and of the corresponding strontium concentration factors were determined for marine organisms. Results of laboratory experiments using double tracer techniques and of determinations based on systematic

measurements of stable strontium and calcium are presented. The organisms studied are common along the Atlantic coastline of Argentina, and consist of various species of fish, crustaceans, molluscs, and marine algae. From the laboratory experiments it was concluded that, with the double tracer technique, it is possible to determine the discrimination factors even before equilibrium conditions have been established. All the organisms studied discriminate against strontium, the discrimination factor values fluctuating between 0.10 and 0.92 depending on the species in question. In the case of fish (Micropogon opercularis) it was found that the Sr/Ca ratios were the same throughout the animal, as was also the case with the exoskeletons and the soft parts of the crustaceans. In the case of the molluscs, different values were obtained for the shells and the soft parts. In general, the discrimination factors obtained in the field on the basis of stable strontium and calcium determinations agree reasonably well with the values obtained in the laboratory for the fish and mollusc species in question and are lower for the crustacean and algae species. Obtaining the concentration factors from discrimination parameters has the advantage of representing limiting situations where the equilibrium state is ensured. In this way, the experimental results can be extrapolated to natural conditions with less uncertainty. The resulting strontium concentration factors fluctuate between 2 and 10 for fish, 13 and 70 for crustaceans and molluscs, and 0.2 and 70 for algae. (auth)

8518 UPTAKE AND LOSS OF ^{65}Zn AND ^{60}Co BY THE MUSSEL MYTILUS EDULIS L. van Weers, A. W. (Reactor Centrum Nederland, Petten). pp 385-401 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

The uptake of ^{65}Zn and ^{60}Co, directly from seawater, by the mussel Mytilus edulis L. and the subsequent loss of radionuclides in nonradioactive seawater were studied with animals kept unfed during the experiments. Concentration factors measured for radionuclides for periods up to 60 days are much lower than the values for the stable elements, which range from 3000 to 11,000 for zinc and from 1200 to 4500 for cobalt in the soft parts. The pattern of loss is described by loss from two relatively short-lived components and one long-lived component, the relative importance of the latter increasing with the length of the preceding uptake period. The biological half-life of the long-lived component ranges from 48 to 60 days for ^{65}Zn and from 57 to 72 days for ^{60}Co. As shown by autoradiography, ^{65}Zn is accumulated to a high extent in the kidney and ^{60}Co both in the kidney and the digestive gland. It is concluded that, as far as uptake of ^{65}Zn and ^{60}Co directly from seawater is concerned, both the relatively slow accumulation and the subsequent loss will reduce the risk of contamination of mussels following incidental releases of these radionuclides in coastal waters. (auth)

8519 ROLES OF FOOD AND WATER IN THE ACCUMULATION OF RADIONUCLIDES BY MARINE TELEOST AND ELASMOBRANCH FISH. Pentreath, R. J. (Fisheries Radiobiological Lab., Lowestoft, Eng.). pp 421-436 of Radioactive Contamination of the Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

A theoretical estimation of the uptake of many radionuclides by fish, and the relevant roles of food and water, is formulated on the basis of known concentration factors. The importance and methods of estimation of biological half-times in such calculations is also discussed. The accumulation of many fission product nuclides (^{137}Cs, ^{106}Ru, ^{144}Ce, ^{90}Sr, ^{134}Cs, ^{65}Zn, and ^{95}Nb) is low due to poor absorption across the gut wall, with the exception of soluble elements such as ^{137}Cs where both food and water play an equal part. For many neutron activation products, however, the contribution from water alone may be considered to be very small. Experimental evidence is given on the accumulation of certain neutron activation products (^{65}Zn, ^{54}Mn, ^{58}Co, ^{60}Co, ^{55}Fe, and ^{59}Fe) from water by both teleost and elasmobranch marine fish in relation to their large stable element pools, water fluxes, and drinking rates. Calculations on the required dietary input are equated with known feeding rates, and the required retention of such elements is compared with results obtained both from labelled pellets introduced into the gut and from labelled food species. The results imply that, unlike ^{137}Cs, which is increased along the food chain, many neutron activation products (heavy metals) are decreased in concentration at such higher trophic levels. The implication of such work for metal toxicity studies is also discussed. (auth)

8520 ELIMINATION OF TRITIUM FROM THE BODY OF THE OFFSPRING OF RATS. Moskalev, Yu. I.; Lyaginskaya, A. M.; Istomina, A. G. Gig. Sanit.; No. 4, 106-108(Apr 1973). (In Russian).

Experiments were conducted on rats in order to evaluate the transmission rate of tritium from the mother's body to the offspring during the postnatal period and the excretion rate of tritium by the offspring. T_2O was introduced into pregnant rats. The droppings and carcasses of the offspring were assayed for tritium at offspring ages of 1, 3, 8, 15, 22, and 30 days; an exponential drop in the tritium content of the organism was observed. The results of the experiments showed that the histohematic barrier-the mammary gland-did not obstruct the passage of the T_2O from the blood to the milk, with the result that the isotope rapidly moved with the milk from the female to the young. (KSW)

8521 ACCUMULATION AND DISTRIBUTION OF ^{90}Sr, ^{137}Cs, ^{144}Ce, ^{106}Ru IN DREISSENA POLYMORPHA PALL. AND LYMNEA STAGNALIS L. Marchyulenene, D. P.; Nyanishkene, V. B. (Inst. of Botany, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. C; No. 2, 141-145(1972). (In Russian).

The experiments carried out with the widely spread representatives of the investigated freshwater molluscs have shown that the accumulation and distribution of radionuclides in different body parts of the molluscs varied greatly. The major site of the nuclides accumulation appears to be in the shell. Dreissena polymorpha accumulates ^{90}Sr-97%, ^{137}Cs-77%, ^{144}Ce-92%, and ^{106}Ru-94%. Lymnea stagnalis L. accumulates ^{90}Sr-90% of the total quantity of every nuclide in the whole body. Such distribution of the radionuclides depends upon the ability of mollusc tissues to accumulate radionuclides as well as on their weight ratio. (auth)

8522 DISTRIBUTION OF ^{241}Am IN THE RAT AS INFLUENCED BY DOSE AND THE pH OF THE INJECTION SOLUTION. Seidel, A. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 362-363(Jun 1973).

A study on the metabolic behavior of ^{241}Am in the rat as influenced by the dosage and pH of the injected solution even if injected as citrate is reported. The distribution of the radionuclide (0.5 μCi/kg) in the skeleton, liver, spleen, and lung in relation to the pH of the injection solution in animals sacrificed 6 days after injection is tabulated. The distribution of the radionuclide (pH value 8.0) in skeleton, liver, and kidneys in relation to injected radionuclides of 3.11 μCi/kg and 0.03 μCi/kg in animals sacrificed 15, 25, and 71 days after injection is also tabulated. From these data it is seen that there is no systematic and statistically significant influence of the pH on the distribution pattern of ^{241}Am and contrary to the situation in dogs an increase in the ^{241}Am dose from 0.03 to 3.0 μCi/kg has no influence on its retention by the liver and skeleton of the rat. (UK)

Plants

Refer also to abstract 7894.

8523 (EUR-5000) VEGETABLE POLLUTION THROUGH THE SOIL: CESIUM-137. Magnaval, R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). May 1973. 23p. (In French). Dep. NTIS (U.S. Sales Only) $3.25. EUR FB 40,-.

The measurement of the soil-plant transfer of cesium-137 based on laboratory experiments is compared with the values obtained in situ. These are comparable where the available cesium contents are less than 1%; above this figure the in situ transfer coefficient is less by a factor of two or three. Among the factors influencing indirect contamination, the exchange capacity is mentioned for wheat and the moisture content of the soil and the season for grass. (auth)

8524 DEPOSITION AND RETENTION OF ^{131}I ON GRAYIA SPINOSA FOLLOWING BANEBERRY. Brown, K. W.; McFarlane, J. C. (Environmental Protection Agency, Las Vegas, NV). Health Phys.; 24: No. 6, 680-682(Jun 1973).

A study is reported of the measurement of the deposition of radioactive fallout (^{131}I), following the underground nuclear weapons test Baneberry, on dormant rangeland vegetation 2 miles from the emplacement hole. By comparing the activity on samples of Grayia spinosa to that on planchets placed in the center of the stand of plants it was found that the effective collection surface of these plants is 235 cm^2/g. It is stated that the importance of this work lies in the development of the concept that in the absence of man-made collection systems, plants (even dormant) can provide information about release of fallout materials. (UK)

8525 KINETICS OF AND A PRELIMINARY MODEL FOR THE UPTAKE OF RADIOZINC BY PHAEODACTYLUM TRICORNUTUM IN CULTURE. Davies, A. G. (International Atomic Energy Agency, Monaco). pp 403-420 of Radioactive Contamination of the

Marine Environment. Vienna; International Atomic Energy Agency (1973).

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972). See STI/PUB-313; CONF-720708-.

Using ^{65}Zn-labelling, measurements of the rate of uptake of zinc by initially zinc-free cells of phytoplankton were made. Treatment of a suspension of cells, containing zinc with a chelating agent indicates that a portion of the metal associated with the cells is loosely bound and probably adsorbed on to the cell surface. The remainder of the metal in the cell is more firmly based. In the early stages of uptake, it increases linearly with the square root of time and this was taken to indicate that the uptake of the metal is passive and diffusion controlled. The metabolic zinc content of the cells later passes through a maximum despite the availability of further zinc for uptake and then gradually decreases. This was interpreted as being due to a reduction in the number of zinc-binding sites (probably protein) within the cells, as they progress through their growth cycle. A simplified model of these events, capable of computerization, was developed and tested against the experimental observations. (auth)

8526 LEVELS OF STRONTIUM-90, STABLE STRONTIUM, AND CALCIUM IN AURANTIACEAE OF THE GEORGIAN SSR IN 1965-1967. Kipiani, R. Ya.; Tvalchrelidze, E. V.; Kvachadze, G. V. Tr. Inst. Zashch. Rast., Tiflis; 21: 355-357(1969). (In Russian).

Using the radiochemical method of A. K. Lavrukhina, et al. (1963), the ^{90}Sr content in various parts and the fruits of mandarin, lemon, and orange trees was determined. Flame photometry was used to determine the stable strontium and calcium contents. The ^{90}Sr distribution among the parts of the trees analyzed was: leaves > bark > branches > peel > wood pulp > peeled fruit. The stable strontium and calcium distribution was: bark > leaves > branches > peels > wood pulp > peeled fruits. (ERB)

8527 DISTRIBUTION OF STRONTIUM-90 IN SEPARATE ORGANS OF CORN AND WHEAT. Kipiani, R. Ya; Modzmanashvili, G. G.; Kvachadze, G. V. Tr. Inst. Zashch. Rast., Tiflis; 21: 351-354(1969). (In Russian).

Using the radiochemical method of A. K. Lavrukhina, et al. (1963), the ^{90}Sr content in various parts of corn and wheat plants grown in various regions of the Georgian SSR was determined. It was found that the corn and wheat plants contained: in roots 4.3 to 11.6 and 2.4 to 13.7; stems 20.6 to 35.8 and 6.9 to 29.5; leaves 44.7 to 68.7 and 36.8 to 60.4% of the total absorbed ^{90}Sr, respectively. The wheat kernals contained 4.4 to 12.1; wheat husks 7.5 to 35.8; and corncobs 6.3 to 19.2%. The ^{90}Sr distribution in the wheat plant was: leaves > husk > stem > kernels > roots. In the corn plant the distribution was: leaves > stem > cobs > roots. The region of plant growth and climatic conditions effected variations in the ^{90}Sr content in separate plant organs. (ERB)

New Tracer Techniques

Refer also to abstracts 7992, 7993, 8019, 8037, 8039, 8312, and 8504.

8528 PERIPHYTON PRODUCTION AND GRAZING RATES IN A STREAM MEASURED WITH A ^{32}P MATERIAL BALANCE METHOD. Elwood, J. W.; Nelson, D. J. (Oak Ridge National Lab., TN). Oikos; 23: No. 3, 295-303(1972).

Net production rates and standing crops of periphyton and grazing rates on periphyton were measured in a small, woodland stream in southeastern United States using a material balance method. The material balance of radioactive phosphorus was followed at three times during the year in periphyton, consumer organisms, and stream water for up to six weeks following a one-hr release of $^{32}PO_4$ to the stream. Rates of decrease of ^{32}P in periphyton per unit weight, per unit area of substrate, and in the entire study reach of stream were used to compute biomass turnover rates of periphyton and fractions of periphyton standing crop grazed per unit area per unit time. Periphyton standing crops in July, September, and November were estimated at 200, 198, and 658 mg ash-free dry weight m^{-2}, respectively, while estimates of net production rates were 22, 24, and 16 mg ash-free dry weight m^{-2} day^{-1}, respectively. Estimated grazing rates on periphyton during these periods were 23, 15, and 14 mg ash-free dry wt m^{-2} day^{-1}, respectively. Biomass turnover rates of periphyton were in the range of those computed from other stream ecosystems which had higher standing crops and production rates of periphyton. This suggests that grazing limited periphyton production rates in this stream by controlling the standing crop of periphyton. The method is of wide applicability since less than maximum permissible concentrations of radioactive phosphorus were used in the spike releases. (auth)

8529 INVESTIGATIONS ON THE DIGESTION OF FATS AFTER PARTIAL PANCREATECTOMY USING ^{14}C-CAPRYLIC ACID AND ^{14}C-GLYCERYLTRIOCTANATE. Mielke, F.; Glaubitt, D.; Marx, E.; Marx, R.; Hampel, K. E. (Freie Univ., Berlin). (1972). vp. (In German).

From 10th annual meeting of the Society for Nuclear Medicine; Freiburg i. B., Germany (27 Sep 1972).

Measurements of $^{14}CO_2$ exhalation after oral administration of ^{14}C-caprylic acid and, at least one week later, of ^{14}C-glyceryltrioctanate were made in three patients aged 62 to 75 years 2 months after partial pancreatectomy. The results indicate an impairment in intestinal digestion of fats even in cases of clinically optimal substitution therapy. The content of fatty acids in the feces was raised in all patients. (GF)

8530 CLEARANCE METHODS BY MEANS OF RADIOACTIVE ISOTOPES. Oberhausen, E. (1972). vp. (In German).

From 10th annual meeting of the Society for Nuclear Medicine; Freiburg i. B., Germany (27 Sep 1972).

For many years, the only method to determine the clearance of radioactive labeled substances was to measure the excretion of the substances in urine at a constant plasma concentration obtained by means of infusion. Today, whole-body counting offers the possibility to employ a clearance method that not only spares the patient discomfort but requires a considerably lesser time at that. This new procedure and its advantages over the more conventional methods based on the ^{51}Cr-EDTA and the inulin clearance or the determination of the effective renal plasma flow using ^{131}I-hippuran are described. Another new method determines the clearance through the plasma level by way of a one- or two-compartment model. Two procedures were developed in order to investigate the clearance in the two separate compartments, one being described in this paper as it is a fast method that yields sufficient information for clinical purposes and requires practically no further appliance. (GE)

8531 RADIOIMMUNOASSAY OF GROWTH HORMONE IN HUMAN PLASMA. Methodological studies and plasma immunoreactive growth hormone concentration during insulin induced hypoglycaemia in normal children and adults. Hanssen, K. F. (Niels Steensens Hospital, Gentofte, Denmark). Acta Endocrinol.; 71: 649-664(1972).

The double antibody radioimmunoassay (pre-precipitation technique) for the immunoreactive growth hormone (IRHGH) in human plasma has been evaluated on the basis of dilution and recovery experiments and by investigation of accuracy and reproducibility. With optimal conditions for the precipitation, the method seems suitable for determination of plasma IRHGH. No cross-reaction between the precipitating antiserum and human gammaglobulin was demonstrated. Furthermore, with an incubation period of 6 days for the reaction between ^{125}I-HGH and the precipitated HGH antibodies, no serum factor influencing this reaction could be demonstrated. The results of the plasma IRHGH determinations were shown to be independent of the percentage of the radioactive degradation products present in the tracer HGH. The lower detection limit is better than 0.39 ng/ml. The cumulated within-assay coefficient of variation was between 4 to 7% and the cumulated between-assay coefficient of variation 10%. With gel filtration, IRHGH in the plasma was shown to be nonhomogeneous when molecular weight is considered. The normal fasting values in the ambulatory state was (Mean ± SD) ng/ml: Men 1.48 ± 0.33; women 3.83 ± 3.47. During the insulin tolerance test the mean peak plasma IRHGH was lower in children than in adults ($0.02 > P > 0.01$). It is suggested that this is due to the influence of sex steroids in adult subjects. (auth)

8532 NUCLEAR MEDICINE. Scope of nuclear medicine. Quart. Med. Rev.; 22: No. 2, 1-41(Oct 1971).

The scope of nuclear medicine, including diagnosis, radiotherapy, and research, is discussed under the following headings: radioisotopes; types of radiation; measurement of radioactivity; diagnostic radioisotope studies; in-vitro assay procedures; and radioisotopes in therapy. (ERB)

8533 NEUTRON RADIOGRAPHY IN MEDICAL RESEARCH. Reijonen, H. (Valtion Teknillinen Tutkimuskeskus, Otaniemi, Finland); Kormano, M.; Reijonen, K. Duodecim; 89: No. 7, 32-36(1973). (In Finnish).

A review is given of recent developments in medical neutron-radiography and its technical requirements. The authors' own experiments in the neutron-radiography of bone sections have shown that additional information of soft tissue changes in bones and joints is achievable by the combination of selective deuteration with neutron radiography. (auth)

8534 STUDY OF METABOLIC PATHWAYS IN VIVO USING STABLE ISOTOPES. Curtius, H. C.; Voellmin, J. A.; Baerlocher, K. (Univ., Zurich). Anal. Chem.; 45: No. 7, 1107-1110(Jun 1973).

Deuterated tyrosine and leucine were used for the study of their respective metabolisms in man. These labeled compounds were given orally to healthy subjects as well as to patients, and the metabolites and their isotope content analyzed in urine using a combination of gas chromatograph-mass spectrometer. This technique elucidates the metabolic pathways in vivo without risk to the subjects. (auth)

8535 TRANSFORMATION OF AMINOETHYLISOURONIUM SALTS. II. Se-aminoethylisoselenouronium bromide hydrobromide-^{75}Se. Kronrad, L.; Kozak, I. (Ceskoslovenska Akademie Ved, Prague). J. Label. Compounds; 9: No. 1, 117-125(1973).

S-aminoethylisouronium salts, a radioprotective agent, accumulates in the heart tissue. Therefore the Se analog of this substance, labelled with radioactive γ-emitter, could be suitable for scintigraphy detection of ischaemic heart disease. Se-aminoethylisoselenouronium bromide hydrobromide-^{75}Se was prepared and its behavior in aqueous solutions was studied. Because the chemical behavior of both substances is very similar, their behavior in an organism may be expected to be similar too. (auth)

8536 RADIOISOTOPIC STUDY OF THE KINETICS OF THE β AMYLASES. Declume, C.; Oustrin, J. (Centre National de la Recherche Scientifique, Toulouse). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 305-310(Jun 1973). (In French).

A radioisotopic method is proposed to enable the activity of β amylase to be determined even in the presence of inhibitors that interfere with the chemical reactions that form the classic method for the analysis of the reaction product maltose. Starch labeled with ^{14}C, its radiochemical purification and quantitative substrate-product separation by filtration on gel can be employed for several kinds of study. The method has enabled us to identify the manner in which β amylase is inhibited by certain borobenzene derivatives. A hypothesis on the mechanism of this inhibition is proposed. (auth)

8537 MEASUREMENT OF THE ACTIVITY IN AUTORADIOGRAPHIC HISTOLOGIC SECTIONS. Ubios, A. M.; Cabrini, R. L. (Univ. Nacional, Buenos Aires). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 311-314(Jun 1973).

Several measurement methods for the activity determinations in autoradiographs of tissue sections are analyzed. The use of a liquid scintillation counter with sections digested with hyamine-hydroxide is recommended as the best method to establish correct exposure time. A definite relation between injected activity, exposure time, and number of grains is obtained. (auth)

8538 PLASMA CORTISONE CONCENTRATION AS MEASURED BY RADIOIMMUNOASSAY. Srivastava, L. S.; Werk, E. E. Jr.; Thrasher, K.; Sholiton, L. J.; Kozera, R.; Nolten, W.; Knowles, H. C. Jr. (Univ. of Cincinnati). J. Clin. Endocrinol. Metab.; 36: No. 5, 937-943(May 1973).

A radioimmunoassay for measurement of cortisone in plasma was developed utilizing rabbit anti-sera against a cortisone-bovine serum albumin complex. To insure specificity, thin layer chromatography was used because unchromatographed samples resulted in 10 to 20% higher values than the chromatographed, even though the cross reactivity with cortisol was only 0.68% and with corticosterone 1.15%. The sensitivity of the assay varies 50 to 79 pg with recovery of cortisone added to plasma found to be 94.2 ± 5.8 (SD). The mean morning plasma level of cortisone in young men was 2.6 μg/100 ml ± 0.5 (SD) and in women 1.96 ± 0.54. Evening levels decreased in relation to cortisol concentration. Pregnant women had elevation of cortisone levels comparable to that of cortisol. After dexamethasone suppression, plasma cortisone levels decreased but following ACTH and usually during acute stress there were no significant changes noted. In patients with severe liver disease, cortisone concentration tended to be lower than normal but directly proportional to cortisol levels whereas in patients with kidney disease cortisone concentration was subnormal. Two patients with Cushing's syndrome had elevated levels of cortisone comparable to cortisol but after o,p'DDD therapy the concentration of cortisone decreased disproportionately thus suggesting an inhibitory effect by the drug on conversion of cortisol to cortisone. The results indicate that circulating cortisone is formed mainly in peripheral tissues with the kidney being a major source. (auth)

8539 RADIOIMMUNOASSAY FOR GONADOTROPIN-RELEASING HORMONE(Gn-RH) IN SERUM. Nett, T. M.; Akbar, A. M.; Niswender, G. D.; Hedlund, M. T.; White, W. F. (Colorado State Univ., Fort Collins). J. Clin. Endocrinol. Metab.; 36: No. 5, 880-885(May 1973).

Double antibody radioimmunoassays were developed to measure gonadotropin-releasing hormone (Gn-RH). Thyrotropin-releasing hormone, melanocyte-stimulating hormone inhibiting factor, various Gn-RH analogs, and the components of serum per se did not appear to influence the assay. Serum containing endogenous or endogenous plus exogenous Gn-RH, crude hypothalamic extracts, and various Gn-RH analogues all produced inhibition curves that were parallel to those obtained with the synthetic Gn-RH standard. Exogenous Gn-RH could be quantitatively recovered from 200 μl of serum obtained from sheep in different reproductive states. Sensitivity of the radioimmunoassay ranged from 1 to 3.8 pg per assay tube with the more sensitive antibody. Using this same radioimmunoassay system the coefficient of variation for 12 samples in the same assay was 5.9% while the coefficient of variation for two samples in six different radioimmunoassays was 14.7%. The level of Gn-RH in serum of normal rams was 71 ± 1.4 (SE) pg/ml as compared to 128 ± 6.1 (SE) pg/ml in the serum of long-term castrate ewes and could be easily measured in 200 μl of serum. The time required for a 50% reduction in serum levels following intracarotid administration of Gn-RH to four sheep was 6.7 ± 1.1 (SE) min. (auth)

8540 IN VITRO AND IN VIVO LABELLING OF ANIMAL TUMOURS WITH TRITIATED THYMIDINE. Denekamp, J.; Kallman, R. F. (Mount Vernon Hospital, Northwood, Eng.). Cell Tissue Kinet.; 6: No. 3, 217-227(May 1973).

The labeling indices obtained by incubating mouse tumor specimens with tritiated thymidine in vitro under hyperbaric oxygen (~10 atmospheres) were compared with those obtained by labeling a matched tumor in vivo. The correspondence between these individual labeling indices was sometimes very poor; however, the average labeling index derived from groups of tumors labeled in the two ways did not differ significantly. There was a large variation from field to field within any tumor, and considerable variation from one tumor to another within each tumor type. The mitotic index was also compared in the matched tumor preparations; the mitotic index in vitro was almost always considerably lower than the values observed in vivo. (auth)

8541 FILTERING SYRINGE AND RADIOIMMUNOASSAYS. Hegesippe, M. (to Commissariat a l'Energie Atomique). French Patent 2,129,003. 27 Oct 1972. Filed date 11 Mar 1971. 5p. (In French).

A filtering syringe for plasma hormone radioimmunoassays is presented. The syringe is constructed of plastic and provided with a filtering device retained at the bottom of the syringe, an absorbent resin being maintained between the filtering device and the piston and a calibrated space being defined during the depression of the piston. The filtering device is made of sintered glass, metal, or a plastic material. The syringe is closed by a plug. Assays are performed with the syringe in the following manner: the resin is maintained in an appropriate liquid which is evacuated before the syringe is used; the solution containing the labeled substance to be assayed is drawn across the filtering device; the solvent is evacuated, the labeled substance being fixed on the resin. The syringe is then placed in a counter and the relative amounts of labeled substance fixed are determined. (France)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 8042, 8195, 8620, 8626, 8633, 8637, 8643, 8661, 8671, 8762, 8781, and 10120–10122.

8542 (AD-753392) LABORATORY METHOD FOR THERMAL FRACTURE OF GRAPHITE. Report for December 1970–May 1972. Eckert, H. U. (Aerospace Corp., El Segundo, Calif.). 31 Oct 1972. Contract F04701-72-C-0073. 41p. (SAMSO-TR-72-275). NTIS.

A method was developed for producing thermal stress failure in ATJ-S graphite and the initial results are described. Test specimens are 10-cm-long hollow cylinders with outer and inner radii of 1.9 and 0.4 cm, respectively. The outside is heated by induction at a frequency of 1.4 MHz by a 100-kW power oscillator; the inside is kept below 100°C by forcing water at a rate of 5 g/m through the copper-coated bore. A special lead-soldering technique was developed to fasten the coolant ducts to the specimen. The inductor coil is protected by an oil bath against heat and electric breakdown. (auth)

8543 (CEA-CONF-2190) BEHAVIOR UNDER NEUTRON IRRADIATION OF MATERIALS INTENDED FOR THE PROTECTION OF NUCLEAR REACTORS. Yvars, M.; Degas, P.; Quetier, M.; Rousseau, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 17p. (In French). (CONF-721018-20). Dep. NTIS (U.S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Various materials were developed for fast neutron reactor shielding purposes: graphites, absorbent or nonabsorbent baked graphites, and boron carbide. These materials might also have applications for uses in conjunction with other types of reactor, particularly high temperature reactors. The physicochemical properties, the composition, the mechanical and thermal characteristics and the desorption of the occluded gases as a function of temperature were studied. In addition, the resistance of sintered boron carbide to thermal shocks was investigated. The quantities of the various products found in the molten sodium at 600 deg C were measured in the framework of fast neutron reactor shielding studies. Indications are given of the modifications occurring in these properties as a result of neutron irradiation at 600 deg C, the doses considered being of the order of 8×10^{21} n·cm^{-2} (E > 0.1 MeV). (auth)

8544 (CONF-730601-2) REMOTE COATING OF HTGR FUEL PARTICLES. Lackey, W. J.; Pechin, W. H.; Sease, J. D. (Oak Ridge National Lab., Tenn.). 1973. 12p. Dep. NTIS $3.00.

From 11th biennial conference on carbon; Gatlinburg, Tennessee, USA (4 Jun 1973).

Equipment and processes are being developed to allow remote coating of 350-μm-dia $(Th_{0.81}, {}^{233}U_{0.19})O_2$ recycle fuel particles in the TURF pilot plant at the rate of 10 kg of heavy metal per day. Carbon coatings and perhaps SiC coatings will be required. Particles having the desired coatings have been produced in 1- to 3-kg batches in a fluidized bed 5-in.-dia prototype furnace. (auth)

8545 (DP-Report-666) PERFORMANCE OF THERMAL INSULATION IMMERSED IN HELIUM. Dragon Project. Kinkead, A. N.; Pitchford, B. E. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 29p. (CONF-691112-6). Dep. NTIS (U. S. Sales Only) $3.50.

From 2nd conference on prestressed concrete reactor pressure vessels and their thermal insulation; Brussels, Belgium (18 Nov 1969 dated 20 Nov 1969).

Although very extensive research programs have been carried out for the development of suitable forms of insulation for the interior of carbon-dioxide-cooled reactors, relatively little attention has so far been paid to insulation appropriate to helium cooling. The considerably different properties of these two gases necessitate a completely fresh design approach for the helium insulator. The Dragon Project has embarked on an insulation test program utilizing a former gas bearing circulator rig. It is hoped that, in spite of the small scale of this test, useful results will be obtained for mineral fiber, metal fiber, and metallic multilayer foil types, particularly with regard to forced-circulation pressure drop along the length of the specimens. The rig and test proposals are described. An approximate analysis is included for performance evaluation of multilayer insulation in vertical gas spaces including the regime between fully suppressed natural convection and that for which an accepted power relationship applies. This simplified method neglects insulator permeability on the basis, already partially substantiated by experiment, that with helium as the interstitial medium under stagnant conditions, global circulation within the thickness of the insulator is a less-significant factor than with carbon dioxide. Results from a computer program utilizing the analysis are presented. (auth)

8546 (DP-Report-677) DEPOSITION AND STRUCTURE OF PYROLYTIC SILICON CARBIDE. Dragon Project. Voice, E. H.; Lamb, D. N. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 86p. (CONF-691140-5). Dep. NTIS (U.S. Sales Only) $6.50.

From Fuel symposium; Bournemouth, UK (4 Nov 1969).

Silicon carbide was pyrolytically deposited from methyltrichlorosilane in a fluidized bed of Dragon nuclear-fuel microspheres to form a fission-product barrier. The nature of the fluidizing process was examined. The effects of varying the major deposition parameters (temperature and reactant concentration) were studied and related to the surface form and internal structure of the deposits. A hypothesis is put forward to explain the features of the layers and their behavior during high-temperature treatment. Evidence for a complex pyrolytic reaction path is given and an intermediate product described. Comments are included on relating results from different fluidized bed systems. The characteristics of an "ideal" silicon carbide fission-product barrier are listed. (auth)

8547 (DP-Report-683) MODEL FOR STRESS ANALYSIS IN COATED FUEL PARTICLES. Dragon Project. Walther, H. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 28p. (CONF-691140-6). Dep. NTIS (U.S. Sales Only) $3.50.

From fuel symposium; Bournemouth, UK (4 Nov 1969).

A theoretical model was developed for stress analysis in spherical multilayer-coated fuel particles. The stress analysis can be performed over all the lifetime of the particle. The theoretical model description is repeated, adding several parts not formerly included. One part is the general basis from which mathematical treatment starts, which may also be useful for other kinds of stress analyses with plastic deformations. Another part is the consideration of dimensional changes and mechanical coupling of the kernel as a consequence of fuel swelling. A third part added to the formulation of the failure process. (auth)

8548 (EIR-236) SOL–GEL PROCESSES FOR CARBIDE PREPARATION. Status Report from Switzerland. Bischoff, K.; Lloyd, M. H.; Schumacher, H. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). May 1973. 35p. (CONF-730524-2). Dep. NTIS (U.S. Sales Only) $3.75.

From panel on sol-gel processes for fuel fabrication; Vienna, Austria (21 May 1973).

Work on sol–gel processes at EIR is described. The principal objective of the program is directed toward studies of uranium–plutonium carbide spherepack fuel prepared by sol–gel processes. The work includes fuel and specimen preparation, irradiations, and post-irradiation examination. Fuel is prepared principally by internal gelation techniques based on the KEMA U(VI) process. Modifications required to introduce plutonium and carbon are described. Several studies were initiated to better understand the basic mechanisms involved in microsphere preparation. These include the reactions involved during preparation of concentrated low-acid Pu(IV) feed and the effects of process variables on the crystal habit and crystallization behavior of urania during gelation. The preparation of fuel specimens by vibratory compaction of two size fractions of microspheres is briefly discussed, and the program for irradiation of sol–gel carbides is described. (5 tables, 10 figures, 10 references). (auth)

8549 (GERHTR-44) INVESTIGATIONS ON THE PREPARATION OF UO_2 MICROSPHERES BY INTERNAL GELATION OF A UO_2 SOL AND FROM A URANIUM(VI) SOLUTION. Foerthmann, R.; Naoumidis, A.; Nickel, H.; Burck, W. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Apr 1970. 19p. (Jul-655-RW). Dep. NTIS (U.S. Sales Only) $3.00.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

A sol–gel process based on the application of the internal gelation technique to concentrated low-pH urania sols is described. The results of laboratory investigations on the preparation of UO_2 microspheres with diameters of 500 to 1000 μ and more by this sol–gel process are given. A second process for preparing UO_2 microspheres is described starting from a uranium(VI) solution which is directly processed to spherical UO_3 particles. The con-

ditions for the heat treatment of these particles yielding UO_2 microspheres in the diameter range of 100 to 900 μ are given. (auth)

8550 (ORNL-TM-4105) FUELS AND MATERIALS DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1972. Patriarca, P. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 240p. AT $14.00.

Research and development progress during the period is summarized in 5 sections. A separate abstract was prepared for each section. (JRD)

For abstracts of individual sections see: 8551, 8624, 8634, 8666, and 8759.

8551 (ORNL-TM-4105, pp 1.1-1.8) DEVELOPMENT OF FBR NEUTRON-ABSORBER MATERIALS. May 1973.

In fuels and materials development program quarterly progress report.

A preliminary assessment of the reactivity worth of Eu_2O_3 has been completed. Calculations based on available information indicate that Eu_2O_3 and natural B_4C should exhibit nearly identical initial volumetric reactivity worths. More importantly, the buildup of the principal europium capture products of ^{152}Eu and ^{154}Eu significantly increases the long-term worth of Eu_2O_3 over that of B_4C. The importance of obtaining additional physics information was also identified. Both hot pressing and sintering methods are being evaluated for the preparation of high-density Eu_2O_3 pellets required for irradiation testing. Hot pressing of cubic Eu_2O_3 at about the cubic-to-monoclinic transformation temperature (about 1050°C) was found to result in essentially fully dense, fine-grained monoclinic pellets. Sintering coldpressed cubic Eu_2O_3 at 1750°C yields monoclinic pellets 93.5 to 95.5% dense. (JRD)

8552 SPHERICAL PARTICLE WITH FISSILE NUCLEUS. Bairiot, H. (to Societe Belge pour l'Industrie Nucleaire). Belgian Patent 779,364. 15 Feb 1972. 7p. (In French).

A fuel particle for a nuclear reactor is described that consists of recovered fertile and fissile materials and has an impermeable coating. The particle is characterized by the fact that the fissile material is surrounded by the fertile material. (tr-auth)

8553 FORMATION OF UO_3 PARTICLES IN FLUIDIZED BED. Gonzalez, V.; Otero, A. R. (Junta de Energia Nuclear, Madrid). Powder Technol.; 7: No. 3, 137-143(1973).

A theoretical treatment of the average particle diameter evolution versus time in a fluidized-bed calciner of uranyl nitrate is developed. This evolution is the result of two independent mechanisms: growth and attrition. It has been verified that attrition occurs only during particle formation, becoming negligible in completely calcined particles. The validity of this theory has been demonstrated in tests carried out in a pilot plant reactor of 20-cm diameter by studying the influence of the operating parameters on both mechanisms. (auth)

8554 ACCURATE FABRICATION PROCEDURE OF FUEL PELLETS. Flipot, A. J.; Smolders, A. (to Centre d'Etude de l'Energie Nucleaire). Belgian Patent 781,180. 24 Mar 1972. 10p. (In French).

A process is described for compacting and sintering that permits the fabrication of fuel pellets the variation in the diameter of which is within the range of the tolerances imposed. The rectification stage can thus be avoided. (tr-auth)

8555 POISON FOR NUCLEAR FUELS. Gilissen, R.; Flipot, A. J. (to Centre d'Etude de l'Energie Nucleaire). Belgian Patent 781,976. 12 Apr 1972. 6p. (In French).

A process is described for fabrication of a burnable poison, $3\ Dy_2O_3 \cdot 5Al_2O_3$ and of fuel pellets based on uranium oxide. (tr-auth)

8556 EXPLOSIVE COMPACTION OF CERAMIC AND METAL POWDERS AND THEIR MIXTURES. Pruemmer, R. (Angewandte Forschung eV, Amstetten, Ger.). Ber. Deut. Keram. Ges.; 50: No. 3, 75-81(1973). (In German).

A brief survey of several methods of indirect explosive compaction of ceramic and metal powders is given. The direct method and the underlying physical laws are described. The behavior of porous substances under the influence of shock-waves is calculated. Theoretical–empirical laws are found that allow the formation of cylindrical hollow and full samples. It is essential to adapt the explosive parameters to the characteristics of the powder to be compacted. Aluminum oxide, zirconium oxide, boron carbide, titanium carbide, tungsten, and steel powders, and mixtures as well are compacted to densities greater than 95% of the theoretical value. It is also shown, that geometrical formed samples can be produced by explosive powder metallurgy. (GF)

8557 SOLUBILITY OF OXYGEN IN VANADIUM. Smith, D. L. (Argonne National Lab., IL). J. Less-Common Metals; 31: No. 3, 345-358(Jun 1973).

Three techniques were employed to establish the temperature dependence of the terminal solubility of oxygen in vanadium in the range 200 to 750°C. Internal friction measurements, which indicate the amount of oxygen in solution in a body-centered cubic metal, were used to determine the phase boundary to 400°C. Saturation concentrations at the higher temperatures were determined from oxygen distribution experiments in the V–O–Na system. The low oxygen partial pressures, e.g., 10^{-34}–10^{-47} atm, required for vanadium–vanadium oxide phase equilibrium were obtained by controlling the oxygen concentration in liquid sodium at levels of 0.03 to 20 ppM. The oxygen partial pressures at the three-phase sodium–vanadium–vanadium oxide equilibrium were calculated from measured oxygen concentrations in sodium and from available thermodynamic data for the binary sodium–oxygen system. Gaseous oxidation experiments conducted in a Sieverts' apparatus confirmed that sodium interactions or complex oxidation formation did not affect the previous results. The oxygen concentration of α-vanadium, which is in equilibrium with an oxide designated V_9O, is adequately expressed by the equation $\log C_o^0$ (wt %) = 0.705 – 515 (1/T) ($°K^{-1}$) for the temperature range investigated. (auth)

8558 NONMETALLIC HIGH-TEMPERATURE MATERIALS. Petzow, G.; Buresch, F. E. Z. Werkstofftech.; 3: No. 5, 243-250(1972). (In German).

The properties of some special ceramic materials for high-temperature applications are described and the factors, such as grain size, porosity, etc., affecting these properties are considered. Special ceramics include: carbides, e.g., SiC, B_4C, WC, VC, TiC, ZrC, HfC; borides, e.g., TiB, ZrB_2, HfB_2; oxides, e.g., Al_2O_3, BeO, ZrO_2, MgO, ThO_2; nitrides, e.g., Si_3N_4, AlN, BN, HfN; silicides, e.g., $MoSi_2$ and Ta_5Si_3; and graphite. They exhibit good thermal strength, good corrosion resistance, good resistance to thermal shock and good impact properties. The high-temperature properties of metals and ceramics are compared. Applications for special ceramics are described and possible development areas are reviewed. (18 references) (Metals Abstr.)

8559 REACTION BEHAVIOR OF SUPERSATURATED TUNGSTEN, TITANIUM, AND TANTALUM CARBIDES IN LIQUID COBALT. May, W. Tech. Mitt. Krupp, Forschungsber.; 30: No. 1, 15-48(May 1972). (In German).

Qualitative and quantitative investigations into the structure of (W, Ti, Ta) C–Co alloys and the reaction processes of the mixed carbide phase of (W, Ti, Ta) C–Co alloys are described. The various aspects considered include phase identification, interpretation of inhomogeneity in the mixed carbide structure, discontinuous precipitation, liquid-phase sintering and grain growth, and Ostwald "ripening". Decomposition- and grain growth-transfer constants are compared and discussed. The literature concerning microstructural changes during liquid-phase sintering is reviewed. (59 references) (Metals Abstr.)

8560 L_{β_2} BAND OF NIOBIUM AND THE K_α BAND IN AN X-RAY STUDY OF NbC. Korsunskii, M. I.; Genkin, Ya. E.; Zhurakovskii, E. A.; Lifshits, V. G. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 68-70(1972). (In Russian).

The x-ray bands L_{β_2} of Nb and K_α of C from the compound NbC are discussed. The emission bands of Nb and C were interpreted using representations of collectivized, local bonding, and core electrons. Distorted forms of the bands L_{β_2} of Nb and K_α of C, and parameters of parts of these bands were obtained, reflecting the states of the electrons of the indicated groups. The number of collectivized electrons necessary for the average total volume of atoms of Nb and C in $NbC_{1.0}$ was developed. (tr-auth)

8561 EUROPIUM-151 MOESSBAUER SPECTROSCOPIC STUDIES OF EUROPIC OXIDE. Glentworth, P.; Nichols, A. L.; Large, N. R.; Bullock, R. J. (Univ. of Leeds, Eng.). J. Chem. Soc., Dalton Trans.; No. 9, 969-972(1973).

Europium-151 Mössbauer spectra of europic oxide show a single absorption peak that is both broad and asymmetric as a result of unresolved quadrupole splitting. Attempts to fit such spectra to a single Lorentzian peak have been found to be unsatisfactory. A more satisfactory analysis has been obtained by taking quadrupole splitting into account. The effects of prior heat treatment of europic oxide on the Mössbauer spectra have been investigated, and it is concluded that observed variations in isomer shift are not attributable to the cubic–monoclinic phase transition. (auth)

8562 SYSTEMS TiC–Cr AND ZrC–Cr. Guha, J. P.; Kolar, D. (Univ., Ljubljana, Yugoslavia). J. Less-Common Metals; 31: No. 3, 331-343(Jun 1973).

Phase equilibrium relations in the pseudobinary systems TiC–

Cr and ZrC–Cr were investigated by metallographic and x-ray diffraction methods. Selected samples were analyzed by an electron-probe microanalyzer. Alloys containing various proportions of the monocarbide and chromium were arc-melted in an argon atmosphere using nonconsumable electrodes and were subsequently heat treated at various temperatures, rapidly cooled, and examined for phase identification. Both systems were found to be of the simple binary eutectic type, having partial solid solubility at the ends. Eutectic compositions and their melting temperatures were established, and phase diagrams indicating solidus and liquidus boundaries and the solid solubility limits are presented. (auth)

8563 GROUP VA HYDRIDES: A NEW TYPE OF PHASE TRANSFORMATION. Rashid, M. S.; Scott, T. E. (Ames Lab., IA). J. Less-Common Metals; 31: No. 3, 377-388(Jun 1973).

Vanadium, niobium, and tantalum, metals of Group VA, form hydrides with stoichiometries approaching MH. The characteristics of the formation of vanadium hydride, in particular, are presented. The accumulated evidence suggests that the hydride formation, while exhibiting many features of martensitic transformations is, in fact, nonclassical. A tentative working model for the hydride formation mechanism and the experimental evidence supporting it are presented. (10 figures) (auth)

8564 EXPERIMENTAL REDUCTION OF GRAPHITE REACTOR IRRADIATION DATA TO THE UNIVERSAL SCALE OF DAMAGING FAST-NEUTRON FLUX. Klimenkov, V. I.; Dvoretskii, V. G. At. Energ. (USSR); 34: No. 2, 93-96(Feb 1973). (In Russian).

The problem considered arises from the need to correlate graphite irradiation data for various parameters of neutron media—irradiation in different reactors or at various locations of the same reactor. The case is considered when the neutron flux spectra are not known at reactor locations where graphite irradiation occurs. In such a case, the reduction to the universal scale of damaging fast-neutron flux cannot be performed by calculation. Experimental reduction methods based on the dependence of the radiation change in graphite electrical resistivity on the neutron irradiation dose expressed in the universal scale are described. The experiment consists of the short-term irradiation of a graphite specimen together with a threshold-activation monitor at the reactor location for which the reduction is carried out. The irradiated graphite specimen provides information on the irradiation temperature and damaging neutron flux, and the activation monitor—on the equivalent-fission neutron flux. The comparison allows determination of the factor for converting the integrated fluxes to which the graphite was exposed during irradiation at the given reactor location to the universal scale. There is introduced a criterion of similitude of irradiation conditions, allowing easy determination of an equivalent pair—temperature and density of neutron flux. To simplify the iteration calculations a nomogram is presented. The experiment on the SM-2 reactor yielded results that agree well with the calculation of a conversion factor based on a known neutron flux spectrum. (auth)

8565 HEAT CONDUCTION IN THE UO_2–CLADDING COMPOSITE BODY WITH SIMULTANEOUS SOLIDIFICATION AND MELTING. Epstein, M. (Argonne National Lab., IL). Nucl. Sci. Eng.; 51: No. 1, 84-87(May 1973).

The exact solution is found for the transient temperature field and the progress of phase transformation fronts on both sides of an interface separating two semi-infinite regions. The solution is applied to the problem of initially molten UO_2 contacting its initially solid steel "cladding." (auth)

8566 PREPARATION OF METAL OXIDE GRAINS. Nooth-out, A. J. (to Reactor Centrum Nederland). U. S. Patent 3,728,421. 17 Apr 1973. Priority date 9 Dec 1969, Netherlands. 6p.

A method is disclosed of preparing spherical particles of metal oxide hydrate and metal oxide hydrate with carbon; such particles can be converted into spherical oxide, and if carbon has been incorporated, into carbide particles. Spherical oxides and carbides of actinide metals are used as fissile material in nuclear technics. An aqueous solution of a metal salt is mixed at a low temperature with one or more ammonia liberating agents and subsequently solidified by dispersion in a phase of high temperature non-miscible with water, after which the solid substance obtained is separated, washed and subjected to thermal treatment. (Official Gazette)

8567 MECHANICAL PROPERTIES OF A MAGNESIUM–25 VOL.% BORON PARTICULATE COMPOSITE. Huseby, I. C. (Max Planck-Institut fuer Metallforschung, Stuttgart); Shyne, J. C.; Sherby, O. D. Int. J. Powder Met.; 9: No. 2, 91-93(Apr 1973).

Magnesium–boron particulate compositions are characterized by high specific stiffness and greatly improved mechanical properties compared with those of magnesium; they have isotropic mechanical properties. (auth)

8568 NEW SOLVENT EXTRACTION PROCESS FOR PREPARING PuO_2 SOLS. Lloyd, M. H.; Tallent, O. K. (Oak Ridge National Lab., TN). Nucl. Technol.; 18: No. 3, 205-215(Jun 1973).

A new solvent extraction process for preparing PuO_2 sols was developed. The process has three major operations including extraction of HNO_3 from $Pu(NO_3)_4$–HNO_3 feed with a long-chain alcohol, such as n-hexanol, until a plutonia sol with a NO_3^-/Pu mole ratio of ~1 is obtained, seeding, in which sol is added to the feed solution before or during extraction to create a micelle structure of aggregated crystallites, and thermal denitration, which consists of drying and baking the sol. (auth)

8569 SHORT-RANGE ORDER IN Ni–Mo, Au–Cr, Au–V, AND Au–Mn ALLOYS. Das, S. K.; Okamoto, P. R.; Fisher, P. M. J.; Thomas, G. (Univ. of California, Berkeley). Acta Met.; 21: No. 7, 913-928(Jul 1973).

The nature of short-range order (sro) was investigated in the series of alloys Ni_4Mo, Ni_3Mo, Au_3Cr, Au_4Cr, Au_3Mn, and Au_4V, which exhibit different long-range ordered (lro) structures, by transmission electron microscopy and diffraction. The examination of the sro state, at temperatures above the critical temperatures (T_c) for the order–disorder transformations and also in the samples that were quenched from above T_c, showed diffuse scattering peaks centered near (1 ½ 0) positions in the fcc reciprocal lattice, whose shape changed from one system to another. Evidence for diffuse scattering near superlattice positions corresponding to the D1a structure was obtained in the sro state of Au–Cr, Au–V, and Ni–Mo alloys. Additional diffuse scattering was observed near Ni_2Mo positions in the Ni–Mo alloys. The diffraction patterns of Au_3Mn above T_c showed evidence for diffuse scattering near the superlattice positions corresponding to the Watanabe-type two dimensional long period superstructure. Inclusion of pairwise interaction parameters up to third nearest neighbors in the high-temperature statistical mechanical model of Clapp and Moss partially accounts for the shapes of {1 ½ 0} sro spots found in Ni–Mo and Au–Mn alloys, but not in Au–Cr and Au–V alloys. The shapes of the diffuse sro scattering in the latter alloys, however, can be interpreted in terms of a distribution of various types of imperfectly ordered microdomains existing above the critical temperature. For a particular stoichiometry, the most frequently occurring microdomain may or may not correspond to the equilibrium long range ordered (lro) structure of the alloy. (17 figures, 28 references) (auth)

8570 ANELASTIC STUDIES OF HYDROGEN DIFFUSION IN NIOBIUM. Baker, C.; Birnbaum, H. K. (Univ. of Illinois, Urbana). Contract AT(11-1)-1198. Acta Met.; 21: No. 7, 865-872 (Jul 1973).

The diffusional behavior of hydrogen in niobium was investigated in the temperature range 300 to 20°K using internal-friction techniques. In the high-temperature range, pulse-echo high-frequency measurements were used, while flexural vibrations were used in the low-temperature range. Using these techniques, the frequency dependence, orientation dependence, and concentration dependence of the hydrogen relaxations were studied in high-purity Nb and Nb–O(N) alloys. Relaxation due to two types of hydrogen complexes was observed: (a) hydrogen pairs and (b) oxygen (or nitrogen)–hydrogen pairs. The hydrogen pair was shown to have an enthalpy of motion of 1265 cal/mole and an enthalpy of binding of 1490 cal/mole. The oxygen (or nitrogen)–hydrogen pair was shown to consist of a single hydrogen atom bound to the oxygen interstitial with an enthalpy of about 2000 cal/mole. The hydrogen motion enthalpy in the strain field of the oxygen atom was 3900 cal/mole. The relaxations were shown to obey a classical Arrhenius temperature dependence at high temperatures and to exhibit enhanced relaxation rates at low temperatures. The data were shown to be in agreement with the theory of Flynn and Stoneham for the diffusion of light interstitial solutes. (10 figures, 19 references) (auth)

8571 THERMODYNAMICS OF bcc SOLID SOLUTIONS OF HYDROGEN IN NIOBIUM, VANADIUM, AND TANTALUM. Langeberg, J. C.; McLellan, R. B. (Rice Univ., Houston, TX). Acta Met.; 21: No. 7, 897-902(Jul 1973).

The variation with temperature and composition of the partial molar enthalpy $\overline{H}_u$ and entropy $\overline{S}_u$ of hydrogen dissolved in niobium, vanadium, and tantalum was deduced from the large body of experimental solubility isotherms available for these systems. For all three systems, both $\overline{H}_u$ and $\overline{S}_u$ are virtually independent of temperature for a given solute concentration. Furthermore, $\overline{H}_u$ is independent of hydrogen concentration and $\overline{S}_u$, at high solute concentrations, exhibits large deviations from regular behavior.

Results are discussed in terms of statistical models for interstitial solid solutions. (6 figures, 36 references) (auth)

8572 FACTORS AFFECTING THE SWELLING OF NUCLEAR FUELS AT HIGH TEMPERATURES. Chubb, W.; Storhok, V. W.; Keller, D. L. (Battelle Memorial Inst., Columbus, OH). Nucl. Technol.; 18: No. 3, 231-256(Jun 1973).

The results of a series of irradiations of refractory fuels at cladding surface temperatures from 1000 to 1900°C were examined to determine which factors have the greatest influence on swelling rates at high temperatures. The effect of temperature on swelling rates is so large that it was found desirable to plot the data as Arrhenius functions of temperature in order to assess the relatively smaller effects of cladding restraint, stoichiometry, burnup, distributed voidage, cracks, and other factors. (auth)

8573 EFFECT OF FAST-NEUTRON IRRADIATION ON CERAMICS AND CERAMIC-METAL SEALS. Reichelt, W. H. (Los Alamos Scientific Lab., NM); Ranken, W. A.; Backus, C. E. pp 128-132 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038-.

Results of tests are presented in which specimens of yttria, high-grade alumina, and ceramic-to-metal seals have been irradiated in the EBR-II reactor at a temperature of 750°C to a peak neutron fluence of about 4.6×10 to the 21st nvt. Three types of alumina were included in the test capsule: Lucalox (GE), AD-999 (Coors), and E-37 (Feldmuhle). The ceramic-to-metal seals represented V-Nb brazed Nb/Al-995, Cu-Ni brazed Ni/E-37, and autoclave-bonded Nb-1% Zr/E-37 seals. Postirradiation measurements indicate that volume swelling in Al_2O_3 appears to be a function of grain size and/or of the impurity levels. These results are in agreement with previously reported data. Y_2O_3 displayed no swelling. Metal-to-ceramic seal assemblies swelled but remained vacuum-tight at these fluences. The thermal conductivity of irradiated Y_2O_3 at 750°C is about 70% of that of highly irradiated alumina. (auth)

8574 MEASUREMENT OF THE ELECTRON WORK FUNCTION IN BINARY AND TERNARY TRANSITION METAL-NONMETAL SYSTEMS. Haufler, G. (Univ., Stuttgart); Jucker, J.; Goretzki, H. pp 203-207 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038-.

Binary and ternary transition metal-nonmetal systems are characterized by large homogeneous phase ranges. Therefore, it should be possible to investigate the influence of the nonmetal and metal components on the work function by systematically changing the composition of the samples. Results of measurements taken with binary Nb-C system and with the ternary Zr-Nb-C and Zr-Ta-C systems are reported. The work function was measured using a pulsing voltage procedure and evaluated by the method of Schottky-Richardson. The results clearly indicate that the influence of the interstitial atoms on the work function decreases from the 4a to the 5a metals. (auth)

8575 COMPATIBILITY OF BUFFERED URANIUM CARBIDES WITH TUNGSTEN. Phillips, W. M. (California Inst. of Tech., Pasadena). pp 336-343 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038-.

Results of compatibility tests between tungsten and hyperstoichiometric uranium carbide alloys run at 1800°C for 1000 and 2500 hours are given. These tests compared W-buffered uranium carbide with W-buffered uranium-zirconium carbide. The zirconium carbide addition appeared to widen the homogeneity range of the uranium carbide, making additional carbon available for reaction. Reaction layers could be formed by either of two diffusion paths, one producing UWC_2, while the second resulted in the formation of W_2C. UWC_2 acts as a diffusion barrier for carbon and slows the growth of the reaction layer with time, while carbon diffusion is relatively rapid in W_2C, allowing equilibrium to be reached in less than 2500 hours at a temperature of 1800°C. (auth)

8576 MECHANICAL BEHAVIOR OF REFRACTORY CARBIDES. Upadhyaya, G. S. (Univ. of Roorkee, India). pp 17-34 of High temperature materials. Bombay; Dept. of Atomic Energy (1972).

From Symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

Refractory carbides enjoy an unique position in modern materials because of their complex combination of properties. They have highest melting points, crystallize into NaCl type structure and possess high hardness. A gradual sequence of change in mechanical properties has been observed between IV A metal carbides and VI A metal carbides. The structures appear more complicated when they are considered in relation to the mechanical behavior of any particular refractory carbide within its homogeneity range. The plastic deformation modes have also been found to change from room temperature to brittle to ductile transition temperature. A very handy tool to study such behaviors is hardness measurements at high temperatures. An attempt is made to interrelate the mechanical behavior of these carbides with bond strengths which in their own turn are attributed to electronic structure of refractory carbides. The study includes the mechanical behavior of single crystal as well as polycrystalline aggregates. (auth)

8577 CERAMIC COATING BY PLASMA-SPRAY TORCH. Paithankar, A. S.; Jayakumar (Bhabha Atomic Research Centre, Trombay, India). pp 147-157 of High temperature materials. Bombay; Dept. of Atomic Energy (1972).

From Symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

Techniques for spraying of ceramics by plasma-spray torch are described. A good quality spray coating of alumina and zirconia was achieved on substrates such as mild-steel, stainless steel, and graphite. On account of very good bonding between sprayed ceramic and the substrate, plasma spray technique has been used as coating ceramics on rocket nozzles and on graphite crucibles used for heating metallurgical samples and for other heat-insulation applications. (auth)

8578 DEVELOPMENT OF HIGH-TEMPERATURE OXIDE REFRACTORIES. Rao, S. V. K.; Moorthy, V. K. (Bhabha Atomic Research Centre, Trombay, India). pp 265-280 of High temperature materials. Bombay; Dept. of Atomic Energy (1972).

From Symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

The ultimate properties of ceramic materials have not been developed. It is now realized that the microstructure of finished products has its influence on the properties. The relation between the microstructure and the properties of some of the common oxide refractories is reviewed. Techniques for the manufacture of ceramic fuel (UO_2) with controlled microstructure and density have been discussed. The role of the powder characteristics on sintering behavior, density, and the development of the microstructure are discussed mainly with respect to UO_2. (auth)

8579 REVIEW ON RECENT DEVELOPMENTS IN PREPARATION AND APPLICATIONS OF TITANIUM DIBORIDE. Ganesan, A. K.; Sundaram, M.; Aravamuthan, V. (Central Electrochemical Research Inst., Karaikudi, India). pp 281-295 of High temperature materials. Bombay; Dept. of Atomic Energy (1972).

From Symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

Titanium diboride is an important hard metal that finds innumerable applications as cathode loads in aluminum reduction cells, filter assemblies for molten aluminum, abrasive surfacing on machine parts, and as coating material for tubes surrounding nuclear fuel rods. The various methods of preparation of titanium diboride viz., the direct combination of metal or metal hydride with boron; reduction of oxides of titanium and boron using carbon, magnesium, aluminum and other metals; thermal decomposition of carbides of boron and titanium; fused salt electrolysis of mixed oxides and fluorides of titanium and boron; and vapor phase deposition by decomposition of halides of titanium and boron in the presence of hydrogen, sodium vapor, or aluminum, are presented. Recent trends in the use of titanium diboride cermets are also indicated. (auth)

8580 INFLUENCE OF POWDER CHARACTERISTICS ON THE SINTERING BEHAVIOR OF OXIDE MIXTURES. Mohan, A.; Moorthy, V. K. (Bhabha Atomic Research Centre, Trombay, India). pp 323-335 of High temperature materials. Bombay; Dept. of Atomic Energy (1972).

From Symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

Literature surveys on the sintering of binary oxide systems such as UO_2-ThO_2 reveal widely divergent views on the effect of the composition of the mixtures on their sintering behavior. The presence of the second phase has been reported as beneficial, indifferent or detrimental. No satisfactory and comprehensive explanation of the sintering behavior of mixtures has been given. Sintering studies were carried out on sets of mixtures, over the entire range of composition, which were given different thermal treatments to produce a variation in their initial properties such as particle size, crystallinity, and the extent of interaction between the phases. These powders were sintered in the range of 1250 to 1550°C. A concept has been proposed to explain the sinter-

ing behavior of these mixtures, which is also applicable to other similar oxide systems. (auth)

8581 EFFECT OF HEAT TREATMENT ON THE KINETICS OF ZIRCONIA TRANSFORMATION. Maiti, H. S.; Gokhale, K. V. G. K.; Subbarao, E. C. (Indian Inst. of Tech., Kanpur). pp 353-363 of High temperature materials. Bombay; Dept. of Atomic Energy (1972).

From Symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

The effect of heat treatment on the monoclinic ⇌ tetragonal transformation of zirconia was examined with the help of differential thermal analysis. The technique has been used to distinguish between the isothermal and athermal kinetics of the transformation. Analytical results on as-received samples show isothermal kinetics while athermal kinetics is exhibited by properly heat treated specimens. The change of reaction kinetics is attributed to the increase in crystallite size of the material. Specimens annealed in the tetragonal range display, on cooling, a very rapid transformation rate, which appears as a burst in a number of martensitic transformations in metallic systems. A yttria-doped zirconia sample also shows the burst phenomenon under similar conditions. (auth)

8582 SEMICONDUCTOR BEHAVIOR OF ZIRCONIUM OXIDE. Srivastava, L. P.; Archbold, T. F. (Univ. of Washington, Seattle). pp 365-371 of High temperature materials. Bombay; Dept. of Atomic Energy (1972).

From Symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

The oxidation of zirconium was studied under oxygen atmosphere and in air at a flow rate of the oxidizing gas of 2 std. l/min. The partial pressures of oxygen being maintained at 0.01, .2, and 1 atm. The temperatures at which the oxidation study has been made were selected arbitrarily. These temperatures are 441, 500, 597, 659, 728, 797, and 856°C. The temperatures were monitored by a thermocouple in the gas stream at the specimen level and were controlled within ±6°C. Theoretical considerations based on the analysis of the weight of the zirconium oxide has shown that if the oxide is a semiconductor, the weight of the oxide is a function of the oxygen partial pressure. (JRD)

8583 STRUCTURAL INVESTIGATIONS IN THERMALLY TREATED URANIUM DIOXIDE THIN FILMS DEPOSITED BY ION BEAM SPUTTERING TECHNIQUE. Vasiliu, F. (Inst. of Atomic Physics, Bucharest); Glodeanu, F. Rev. Roum. Phys.; 18: No. 1, 3-7(1973).

A suitable method is presented for thin UO_2 film preparation. Experimental results concerning the structural transformations occurred in thin sputtered UO_2 films during thermal treatment are reported. A high-temperature structural modification $\gamma-U_4O_9$, was observed to occur in sputtered UO_2 films, for annealing temperatures of 1000°C. The results also suggest two alternative possibilities for the higher oxide U_4O_9 formation in thin UO_2 film matrix. (auth)

8584 ELECTRON PARAMAGNETIC RESONANCE AND OPTICAL STUDIES OF THE F_A^+ CENTRE IN MAGNESIUM-DOPED CALCIUM OXIDE. Boas, J. F.; Hall, T. P. P.; Hughes, A. E. (Univ. of Essex, Eng.). J. Phys., C (London); 6: No. 9, 1639-1651(10 May 1973).

EPR and optical spectra of the F_A^+ centre have been identified in calcium oxide doped with magnesium. This centre consists of an electron trapped at an oxygen vacancy with a magnesium ion as one of its nearest neighbors. The EPR spectrum shows the expected tetragonal symmetry, and hyperfine interaction with the 10% abundant ^{25}Mg nucleus confirms the structure of the defect. Optical absorption bands associated with transitions from the "1s" ground state to the "2p" excited state split by the tetragonal field have been identified. Both bands show vibronic structure at low temperatures and their vibronic properties are compared with those of the F^+ band. Annealing studies and a comparison of the ratio of F_A^+ to F^+ centres in various crystals show that the EPR and optical spectra are due to the same centre. A simple theoretical model gives the correct relative shifts of $g_\parallel$ and $g_\perp$, but not their absolute values. The nuclear quadrupole interactions suggest that the Mg ion is displaced away from the vacancy. A surprising result is that the F_A^+/F^+ ratio depends severely on irradiation conditions, being enhanced well above that expected on statistical grounds by electron irradiation at 1 MeV. (auth)

8585 ION-IMPACT EFFECTS WITH OXIDES AT HIGH DOSES. Kelly, R. (McMaster Univ., Hamilton, Ont.); Lam, N. Q.; Murti, D. K.; Naquib, H. M.; Parker, T. E. pp 349-382 of Physics of ionized gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

Besides the amorphization and oxygen loss, ion bombardment also produces crystallization in some oxides. Response of oxides to medium (10^{16}) and high doses (10^{17}) is described and summarized in a table. Experimental methods for characterizing changes in solids are discussed; they include electron diffraction, gas-release spectrometry, electric conductivity, and chemical reactivity. Models for explaining the effects are discussed: ionic-character, thermal-spike, and vaporization. (16 figures, 64 references) (DLC)

8586 PROPERTIES OF CRYSTALS OF YTTRIUM–ALUMINUM GARNETS IRRADIATED BY NEUTRONS. Vakhidov, Sh. A.; Yusupov, A. A. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 70-72(1973). (In Russian).

The influence of neutron radiation on the optical and EPR characteristics of Y–Al garnet crystals (both pure and activated by Nd^{3+}) was investigated. Neutron irradiation caused intense discoloration of the crystals with the appearance of the absorption bands 260, 300, 380, and 480 nm in the absorption spectrum and the bands 420 and 560 nm in the photoluminescence spectrum. The results were compared with those obtained by γ-irradiation of Y–Al garnets. Interpretation of the data revolved around the anion and cation vacancies as generated by neutron bombardment. (tr-auth)

8587 INFLUENCE OF RADIATION ON THE MECHANICAL LOSSES IN THE FERROELECTRIC CERAMIC LEAD ZIRCONATE–TITANATE. Bessonova, E. N.; Gridnev, S. A.; Pavlov, V. S.; Postnikov, V. S. Fiz. Khim. Obrab. Mater.; No. 2, 73-76(1973). (In Russian).

The effect of mixed neutron + γ radiation of a reactor on low-frequency internal friction of a ferroceramic composition of lead zirconate–titanate [$Pb_{0.95}Sr_{0.05}(Zr_{0.53}Ti_{0.47})O_3$ + 3 wt % PbO with or without 1 wt % Nb_2O_5] was studied. Radiation-induced defects lead to a reduction of the internal friction and an increase in the modulus of elasticity at temperatures well removed from a region of phase transition. An increase in the internal friction in the neighborhood of the Curie point was associated with an increase in the number of new phase nuclei and consequently in the area of interphase boundaries. (tr-auth)

8588 STRUCTURAL STUDIES BY ELECTRON MICROSCOPY: HIGH-RESOLUTION OBSERVATIONS ON β-$ZrO_2 \cdot 12Nb_2O_5$. Allpress, J. G. (Univ. of Melbourne); Iijima, S.; Roth, R. S.; Stephenson, N. C. J. Solid State Chem.; 7: No. 1, 89-93(May 1973).

Reliable idealized structures for the β and γ forms of $ZrO_2 \cdot 12Nb_2O_5$ were deduced following the observation of lattice images, recorded at a resolution of about 0.3 nm, from crystals oriented with their short b axes parallel to the incident electron beam. The structure of the β form is confirmed by preliminary results from single crystal x-ray studies. The present observations are compared with previous work on these phases. (auth)

8589 HIGH-RESOLUTION ELECTRON MICROSCOPY OF $TiO_2 \cdot 7Nb_2O_5$. Iijima, S. (Arizona State Univ., Tempe); Allpress, J. G. J. Solid State Chem.; 7: No. 1, 94-105(May 1973).

The defect structure of $TiO_2 \cdot 7Nb_2O_5$ was examined at about 0.3 nm resolution in an electron microscope. Under suitable conditions of crystal orientation and objective lens defocus, the contrast in images from very thin fragments can be interpreted directly in terms of structure. Proposed structures for Wadsley intergrowth defects and displacements are confirmed, and new observations of complex fault bands and grain boundaries are described. Microdomains of $TiNb_{14}O_{37}$, with the structure predicted by Wadsley, have also been found in this material. (auth)

8590 THERMAL DIFFUSIVITY OF URANIUM AND THORIUM DIOXIDES AT HIGH TEMPERATURE. Weilbacher, J. C. (CEN, Fontenay-aux-Roses, France). High Temp.–High Pressures; 4: No. 4, 431-438(1972). (In French).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

The thermal diffusivities of polycrystalline thorium dioxide and of poly- and monocrystalline uranium dioxide have been measured in temperature ranges of 900 to 2550°C and 750 to 2700°C, respectively, using a flash method and an atmosphere of argon or $CO-CO_2$ mixtures. In the case of ThO_2 the diffusivity D decreases steadily with temperature according to the relationship $D^{-1} = 26 + 0.048t(°C)$. For UO_2 the diffusivity is always lower for sintered samples than for single crystals, at least up to 2500°C. It decreases with temperature, but appears to remain constant above 2000°C for sintered samples. A tentative interpretation is presented that takes into account the various contributions to the conductivity at high temperatures. (auth)

8591 RADIATION CENTERS OF PARAMAGNETIC AND OPTICAL ABSORPTION IN LANTHANUM-CONTAINING SILI-

CATE GLASSES. Brekhovskikh, S. M.; Tyul'kin, V. A. Zh. Prikl. Spektrosk.; 18: No. 1, 111-116(Jan 1973). (In Russian).

Radiation-induced centers in $La_2O_3-SiO_2$ and $Na_2O-La_2O_3-SiO_2$ glasses were studied with EPR, electron absorption spectra, and thermal discoloration methods. The samples were exposed to ^{60}Co-emitted gamma rays (10^7 R). Hole centers were produced in alkali-free glasses with up to 5 mole % La_2O_3, which were localized on oxygen ligands of La. Electron E_1' centers were also produced, characteristic of quartz glass lattices. The two alkali-containing glasses studied contained ~18 mole % and ~8 mole % Na_2O, respectively. Chiefly hole centers were produced by irradiating these Na_2O glasses. During thermal de-excitation of the glass at 130°C, destruction of the centers occurred at the SiO_4 nodes and thermally stable hole centers remained at the LaO_n polyhedrons. (KSW)

8592 METHOD FOR THE FABRICATION OF WIRE-TYPE FUEL AND/OR BREEDER ELEMENTS. Drittler, K.; Luhleich, H. (to Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH). German Patent 1,589,861. 31 Aug 1972. 2p. (In German).

A procedure is described for the fabrication of wire-type and/or breeder elements for high-temperature reactors. The procedure is characterized in that the wire-shaped carrier device made of a refractory material is freely supported during the coating process and is coated with a layer of fuel or breeding material and a cladding layer and, if required, also with an intermediate layer consisting of a material capable of retaining the fission products, the various layers amounting to an overall coating thickness that corresponds to an approximate ratio of 1:4 of the wire diameter to the overall coating thickness. Another special feature of the invention is that it uses electrically conductive devices that can be heated up to the temperatures required for the coating process either directly by resistance heating or indirectly by inductive or/and capacity heating. (GF)

8593 SYSTEM MoO_3-UO_3. Ustinov, O. A.; Andrianov, M. A. Chebotarev, N. T.; Novoselov, G. P. At. Energ. (USSR); 34: No. 3, 155-158(Mar 1973). (In Russian).

The interaction of the oxides MoO_3 and U_3O_8 in air has been studied by thermographical and x-ray methods in the range from room temperature to 1000°C. It has been established that the compound UO_2MoO_4, corresponding to the system UO_3-MoO_3, forms during the interaction of MoO_3 with U_3O_8. The diagram of state of the system MoO_3-UO_3 has been plotted. The compound UO_2MoO_4 was found to melt incongruently at a temperature of 980°C. (auth)

8594 MEASUREMENTS OF THE THERMAL CONDUCTIVITY OF PURE Al_2O_3 AND Al_2O_3:Mg. Possible Observation of Fe^{4+} in Al_2O_3. Brown, M. A. (CEN, Grenoble, France). J. Phys., C (London); 6: No. 4, 642-649(28 Feb 1973).

Measurements of the thermal conductivity of "pure" Al_2O_3 and Al_2O_3 doped with Mg have been made in the temperature range 1.3 to 100°K, both before and after γ irradiation at ~77°K. Within the experimental errors, the γ irradiation had no effect on the thermal conductivity of the "pure" Al_2O_3, in contrast to results reported earlier. Al_2O_3:Mg shows resonant phonon scattering at ~19°K which is removed by γ irradiation treatment and replaced by resonant phonon scattering at ~8 and ~100°K, caused by Cr^{2+} ions present as an impurity. The γ-irradiated state is unstable, annealing at room temperature within a few hours. The phonon scattering at ~19°K is tentatively interpreted in terms of scattering by Fe^{4+}, which has not been previously observed in Al_2O_3. (auth)

8595 VAPORIZATION OF LIQUID RARE EARTH OXIDES IN A CONTROLLED ATMOSPHERE. Study of the Phases Obtained by Rapidly Cooling Vapors. Coutures, J. P.; Coutures, J.; Renard R.; Benezech, G. (CNRS, Montlouis, France). Compt. Rend., Ser. C; 275: No. 21, 1203-1206(20 Nov 1972). (In French).

Various rare earth and yttrium oxides were distilled in a hydrogen or nitrogen atmosphere maintained at atmospheric pressure. X-ray examination at room temperature of the phases obtained when these high-temperature vapor oxides were rapidly cooled revealed monoclinic structures. The weight losses due to vaporization and the deviations from stoichiometry were determined. The a, b, c, and β parameters of the monoclinic unit cell belonging to the C2/m space group were calculated. (FR)

8596 DIFFUSIVE-CONTROLLED PROCESSES IN REGION OF HOMOGENEITY FOR ZIRCONIUM CARBIDE. Spivak, I. I.; Andrievskii, R. A.; Klimenko, V. V. Porosh. Met., Akad. Nauk Ukr. SSR; No. 3, 43-46(Mar 1973). (In Russian).

Non-monotonous character was established of a change in efficient diffusion coefficients in the zirconium carbide homogeneity region for the case of diffusive creep. It results from experimentally established dependence of creep rate on stress and grain size. (auth)

8597 HARD ALLOYS WC-Co AS DISPERSION-STRENGTHENED MATERIALS. Kreimer, G. S.; Tumanov, V. I. Porosh. Met., Akad. Nauk Ukr. SSR; No. 3, 31-38(Mar 1973). (In Russian).

It was established that changes in the yield limit and hardness of WC-Co alloys depending on composition and size of carbide grains are in agreement with the predictions of the Orovan and Ansell-Linell theories for dispersion-strengthened alloys. Therewith inter-particle distances determining the yield limit and hardness must have values about 10^{-5} to 10^{-6} cm, which is confirmed by observations by means of an electronic microscope. (auth)

8598 THERMODYNAMIC PROPERTIES OF REFRACTORY CARBIDES IN TEMPERATURE RANGE OF 0 TO 3000°K. III. Zirconium Carbides. Turchanin, A. G.; Guseva, E. A.; Fesenko, V. V. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 3, 47-50(Mar 1973). (In Russian).

On the basis of experimental data of zirconium carbide heat capacity at low temperatures, an equation is deduced averaging the values of the heat capacity. The values were obtained in different studies within a wide temperature range. By means of estimated values for niobium carbide heat capacity, its th -modynamic properties are tabulated within the range of 0 to 3000°K. (auth)

8599 18th NATIONAL SAMPE SYMPOSIUM AND EXHIBITION. Volume 16. New Horizons in Materials and Processing. Conference Held at Los Angeles, California, April 3-5, 1973. Science of Advanced Materials and Process Engineering Series. Azusa, CA; Society for the Advancement of Material and Process Engineering (1973). 644p. (CONF-730422-). $35.00.

From symposium on new horizons in materials and processing; Los Angeles, California, USA (3 Apr 1973).

Thirty-four papers were presented at the symposium. A separate abstract was prepared for each of four papers selected as being in the scope of NSA. (JRD)

For abstracts of individual papers see: 8600-8602, and 8742.

8600 THERMAL CYCLING IN BORON-ALUMINUM COMPOSITES. Dardi, L. E. (Howmet Corp., Muskegon, MI); Kreider, K. G. pp 125-139 of 18th National SAMPE Symposium and Exhibition. Vol. 16. Azusa, CA; Society for the Advancement of Material and Process Engineering (1973).

From Symposium on new horizons in materials and processing; Los Angeles, California, USA (3 Apr 1973). See CONF-730422-.

Thermal cycling of 50 vol % 4.2 mil BORSIC + 6061-F aluminum matrix composites between 70 and 670°F was found to cause void formation within the matrix of both unidirectional and complex laminate materials as a result of plastic strains caused by differences in thermal expansion coefficient among the constituents. These voids result in decreased density and reduced flexural moduli in complex (±45, 0, ±45°) laminates (20% after 5000 cycles). The flexural strength of unidirectional material decreases by approximately 13 percent after 5000 cycles. Cyclic life can be calculated approximately using a form of the Manson-Coffin law. A number of techniques were used to monitor the effects of the thermal cycling in both the unidirectionally reinforced material and the complex laminates. These included measuring the linear dimensions, density, flexural strength, flexural modulus, microstructural void formation, ultrasonic wave attenuation, and dynamic modulus. The results from these various investigations are correlated and an analysis of the performance of the material in applications such as jet turbine compressor blades is given. (auth)

8601 AlB_2 FLAKE REINFORCED COMPOSITES. Wohrer, L.; Wosilait, A.; Economy, J. (Carborundum Co., Niagara Falls, NY). pp 340-368 of 18th National SAMPE Symposium and Exhibition. Vol. 16. Azusa, CA; Society for the Advancement of Materials and Process Engineering (1973).

From symposium on new horizons in materials and processing; Los Angeles, California, USA (3 Apr 1973). See CONF-730422-.

The reinforcing potential of AlB_2 flakes in resinoid matrixes was investigated. It was shown that the ratio of flake diameter to thickness is a controlling factor of composite properties. Flake composites displaying flexural strength and modulus of 109×10^3 psi and 43×10^6 psi, respectively, have been observed. The effects of volume loading, voids and machining on composite properties are described. (auth)

8602 NEW FIBER FOR MAKING HIGH-MODULUS COMPOSITE MATERIALS: BORON-CARBIDE-COATED BORON FILAMENT. Morin, D. (Societe Nationale des Powdres et Explosifs, Bouchet, France). pp 599-618 of 18th National SAMPE Symposium and Exhibition. Vol. 16. Azusa, CA; Society for the Advancement of Material and Process Engineering (1973).

From symposium on new horizons in materials and processing; Los Angeles, California, USA (3 Apr 1973). See CONF-730422-.

Boron filament coating, by chemical vapor deposition of boron carbide, was investigated; for well-defined conditions this process leads to fibers having mechanical properties higher than those of initial boron filaments. The incorporation of these new fibers, particularly in aluminum alloy matrices, permits the construction of outstanding composite materials. (auth)

8603 METHOD FOR REDUCING THE OXYGEN IN CERTAIN ACTINIDE OXIDES TO LESS THAN STOICHIOMETRIC LEVELS. Lindemer, T. B.; Bradley, R. A. (to United States Atomic Energy Commission). U. S. Patent 3,717,582. 20 Feb 1973. Filed date 21 Apr 1971. 6p.

The oxygen content of actinide oxide nuclear reactor fuels is reduced to a value less than stoichiometric (oxygen-to-metal atomic ratio less than two, i.e., MO_{2-x}) for inhibiting corrosion or pressurization of the cladding used about the fuel. Actinide oxide particles, e.g., uranium–plutonium oxide particles, with an oxygen-to-metal atomic ratio of about two or greater (MO_{2+x}) are disposed in close proximity to carbon and contacted with carbon monoxide while at a temperature in the range of 700 to 2000°C. The CO effects diffusion of oxygen from the particles in the form of oxygenated CO, e.g., CO_2, to the carbon where the CO_2 reacts to form CO. By controlling the pressure of the CO and the temperature, a CO-to-CO_2 ratio is provided to fix the oxygen-to-metal ratio of the oxide at the desired substoichiometric value. (Official Gazette)

8604 METHOD OF PRODUCING FUEL AND/OR BREEDER ELEMENTS FOR NUCLEAR REACTORS. Boettcher, A.; Nickel, H. (to Kernforschungsanlage Gesellschaft mit Beschrankter Haftung). U. S. Patent 3,723,581. 27 Mar 1973. Filed date 18 Apr 1969. 4p.

Coated particles used in making fuel and/or breeder elements are mixed with carbides and then heat hardened to form a compound member. (auth)

8605 CONDITIONS OF FORMATION OF THE β-U_3O_8 PHASE. Tsvigunov, A. N.; Kovba, L. M. Sov. Radiochem. (Engl. Transl.); 14: No. 5, 788-789(1972).

Translated from Radiokhimiya; 14: No. 5, 765-766(1972).

A comparison of the literature data on the synthesis and investigation of single crystals of α-U_3O_8 and β-U_3O_8 indicates that the formation of single crystals of β-U_3O_8 evidently occurs in the following way. As a result of prolonged high-temperature annealing, crystals of α'-$U_3O_{8(hex)}$ are formed. Subsequently, when the temperature is lowered, the phase transition α'-$U_3O_8 \rightarrow \alpha$-$U_3O_8$ occurs, leading to the formation of twins of α-U_3O_8. This in turn leads to the appearance of local stresses. Probably the value of the shearing stress in the twinning system is such that a process of slipping (shear) develops, resulting in the polymorphic transformation α-$U_3O_8 \rightarrow \beta$-U_3O_8. It is theorized that, in the case of slow cooling and under conditions close to equilibrium, crystals are oxidized to the composition $UO_{2.67}$. In this case a polymorphic transformation without passage through a two-phase region is possible. Thus, the creation of shearing stresses in α-U_3O_8, both in the case of a powder and in the case of crystals, is a necessary and sufficient condition for the formation of the β-U_3O_8 phase. (JGB)

8606 ELECTRON IRRADIATION DAMAGE IN MAGNESIUM OXIDE. Sharp, J. V.; Rumsby, D. (Atomic Energy Research Establishment, Harwell, Eng.). Radiat. Eff.; 17: No. 1-2, 65-68 (Jan 1973).

High densities of small defect clusters were observed in MgO irradiated in the high-voltage electron microscope. The threshold voltage at nominal room temperature was determined as 480 ± 10 kV, corresponding to 64 ± 2 eV for the displacement energy of the magnesium ions. This energy is very similar to the value for oxygen ion displacement from optical absorption studies on accelerator-irradiated specimens. The similarity of the displacement energy for the two ions is discussed and the values compared with those for other ceramic materials. Calculations of the displacement cross sections show that, at 600 kV, the rate of production of oxygen ions is a factor ~1.8 higher than the rate for magnesium ions, whereas at 1 MV the rates are very similar. The effect of increasing dose and irradiation temperature on the defect clusters was investigated, and the results are compared with neutron irradiation damage in MgO and electron irradiation damage in other materials. (auth)

8607 FESTIGKEITS- UND DIFFUSIONSPROBLEME VON HOCHTEMPERATUR-REAKTOR-WERKSTOFFEN. (Stability and Diffusion Problems of High-Temperature Reactor Materials. Conference on Radiation Effects on Materials, Hamburg, Germany, October 22, 1971). Melkonian, G. A. (ed.). KEST Nr. 22. Munich; Verlag Karl Thiemig KG (1972). 135p. (CONF-711074--). $4.25.

From Radiation effects on materials; Hamburg, F. R. Germany (22 Oct 1971).

Five papers were presented at the conference. A separate abstract was prepared for each paper. (JRD)

For abstracts of individual papers see: 8608–8611, and 8815.

8608 MODEL FOR STRESS ANALYSIS IN COATED PARTICLES: ITS POSSIBILITIES AND PROBLEMS. Bongartz, K. (Kernforschungsanlage, Juelich, Ger.). pp 1-13 of Festigkeits- und Diffusionsprobleme von Hochtemperatur-Reaktor-Werkstoffen. Melkonian, G. A. (ed.). Munich; Verlag Karl Thiemig KG (1972). (In German).

From Radiation effects on materials; Hamburg, F. R. Germany (22 Oct 1971). See CONF-711074--.

On the basis of the Walther model, calculations were performed for particles with an intermediate layer of SiC. The life expectancy of the particles was independent of the thickness of the SiC layer, as well as of the internal and external layers of pyrocarbon. The life expectancy, however, increased strongly with greater porosity of the core and with smaller radius. After exposure to fast neutrons at a higher dose rate, sections of the particles were studied. Rupture of all three layers occurred. Several methods for improvement of the coating were suggested. (HBG)

8609 EXTERNAL MECHANICAL EFFECTS ON COATED PARTICLES. Drittler, K. (Technische Ueberwachungsvereine eV, Cologne). pp 15-53 of Festigkeits- und Diffusionsprobleme von Hochtemperatur-Reaktor Werkstoffen. Melkonian, G. A. (ed.). Munich; Verlag Karl Thiemig KG (1972). (In German).

From Radiation effects on materials; Hamburg, F. R. Germany (22 Oct 1971). See CONF-711074--.

In gas-cooled high-temperature reactors, the coated particles usually are arranged as a compound body. In the particles as well as in the matrix of the compound body, radiation causes stresses that can lead to far-reaching damages. Results of stress calculations for matrix and model compound bodies are presented. Comparison of the results with experimental data shows very good agreement. An evaluation of pressure experiments on single coated particles is included. From the deformation under the pressure of two horizontal plates, the elasticity modulus of the external coating layer can be determined, while the breaking stress of the layer can be derived from breaking pressure and ultimate deformation. Because of the small amount of equipment involved, the two procedures are suitable for large experimental series and for measurements under difficult conditions, such as after long-term irradiation. (tr-auth)

8610 THEORETICAL EQUATIONS FOR SOLUTION OF DIFFUSION PROBLEMS IN HTR MATERIALS. Schmidt, A. (Hochtemperatur-Reaktorbau, Mannheim, Ger.). pp 55-73 of Festigkeits- und Diffusionsprobleme von Hochtemperatur-Reaktor-Werkstoffen. Melkonian, G. A. (ed.). Munich; Verlag Karl Thiemig KG (1972). (In German).

From Radiation effects on materials; Hamburg, F. R. Germany (22 Oct 1971). See CONF-711074--.

Aspects of the theoretical treatment of fission-product transport through fuel-element materials are discussed. Based on the diffusion equation and on the possible boundary conditions, several processes are examined that can influence decisively the transport of fission products. In a survey, the available computer programs for the solution of diffusion problems are briefly explained. (tr-auth)

8611 EXPERIMENTAL DETERMINATION OF THE DIFFUSION COEFFICIENT OF STRONTIUM IN MATRIX GRAPHITE. Williamowski, M. (Univ., Hamburg). pp 97-133 of Festigkeits- und Diffusionsprobleme von Hochtemperatur Reaktor-Werkstoffen. Melkonian, G. A. (ed.). Munich; Verlag Karl Thiemig KG (1972). (In German).

From Radiation effects on materials; Hamburg, F. R. Germany (22 Oct 1971). See CONF-711074--.

An apparatus was developed that permitted determination of stable strontium diffusion in matrix graphite for high-temperature reactors. The experiments were conducted isothermally at temperatures between 950 and 1150°C and for durations from 10 minutes to 30 hours. Tubes of matrix graphite were filled with a mixture of SrO and graphite. At the end of the experiment, layers from the surface of the tubes were removed by a lathe and the strontium content was determined by atomic absorption spectrophotometry. From a mathmetical equation for the diffusion in a cylinder, the diffusion coefficient was then obtained. (HBG)

8612 BEO AS A WINDOW IN THE VACUUM UV. Peterson, C. W. (Physics Department and Institute of Materials Science, University of Connecticut, Storrs, Connecticut 06268); Palma, G. E. J. Opt. Soc. Am. 63: No. 3, 387-388 (Mar 1973).

Index Headings: Beryllium; Ultraviolet; Absorption. (auth)

The optical absorption edge in BeO was measured for its intrinsic interest in specifying the band structure of this alkaline earth

oxide and because of the potential use of BeO as a new window in the vuv region. (CES)

8613 SIMPLEX-GRID PLANNING FOR CONSTRUCTING FUSING DIAGRAMS IN THE SYSTEM $BaO-ZrO_2-Al_2O_3$. Mel'nik, M. T.; Ilyukha, N. G.; Bernshtein, V. L. (Kharkov Polytechnical Inst.). Refractories (USSR) (Engl. Transl.); 13: No. 7-8, 542-544(1972).

Translated from Ogneupory; 13: No. 8, 54-56(Aug 1972).

The possibility of using statistical methods of planning extreme experiments for constructing fusibility diagrams for a triple-component system was demonstrated. The calculated fusibility diagram for the system $BaO-ZrO_2-Al_2O_3$ was constructed in which a region for super-refractory compositions was distinguished. The resulting data should be corrected on the basis of experimental determinations of the refractoriness, since the calculations do not take into account the real reactions in the ternary mixtures. However, the volume of experimentation in this case is sharply reduced. (auth)

8614 PHASE INVERSIONS AND PROPERTIES OF REFRACTORIES IN THE SYSTEM $MgO-Al_2O_3-ZrO_2$. Suvorov, S. A.; Kozlova, O. B. (Leningrad Inst. of Tech.). Refractories (USSR) (Engl. Transl.); 13: No. 7-8, 533-537(1972).

Translated from Ogneupory; 13: No. 8, 46-50(Aug 1972).

In the compositions for the system $MgO:Al_2O_3:ZrO_2 = 1:1:1$ fired at 1750°C, with the use of original components of different chemical activity, conditions are created for partial stabilization of the monoclinic zirconium dioxide on account of the magnesia which has not succeeded in reacting with the alumina, resulting in the formation of spinel. The presence in the fired products (together with monoclinic zirconia) of its cubic modification makes it actually possible to obtain thermal shock resistance and strong refractories on the basis of this system. The maximum quantity of stabilizing zirconium dioxide is present in the sinters in which chemically active ZrO_2 obtained by the thermal decomposition of zirconium nitrate and high-temperature fired magnesium oxides are used. The quantity of stabilized ZrO_2 in these sinters is about 70%. The quantity of stabilized zirconium dioxide in the compositions $MgO-Al_2O_3-ZrO_2$ depends on the activity of the alumina employed, as with the magnesium oxide, which is connected with the rate and temperature of formation of the magnesia spinel. The maximum quantity of cubic solid solutions is formed with the use of less-active alumina. The technical properties of the products from firing these compositions are determined not only by their phase composition but also the distribution of the phases in the volume of the specimen. (auth)

8615 EFFECT OF FISSION SPIKES ON FISSION GAS RESOLUTION. Blank, H.; Matzke, H. (European Inst. for Transuranium Elements, Karlsruhe, Ger.). Radiat. Eff.; 17: No. 1-2, 57-64(Jan 1973).

From 74th annual meeting of American Ceramic Society, Nuclear Division; Washington, DC (8 May 1972).

The atomic collision model of fission gas re-solution was refined by calculating the temperature dependence of the re-solution parameter η. In this way it is shown that the atomic collision model is valid only at $T < 400$°C, whereas in uranium oxide fuels at $T > 1000$°C a new and more effective re-solution mechanism operates. As a new mechanism in oxide fuels, the interaction of fission gas bubbles of diameters up to 500 Å with the hydrostatic pressure component of the thermoelastic stress field of fission spikes is proposed and its efficiency in the temperature range $200°C < T < 2200°C$ is discussed qualitatively. In contrast to oxides this mechanism is absent in carbide and nitride fuels and hence practically negligible fission gas re-solution should exist in these fuels at higher temperatures. (auth)

8616 NEW METHOD OF EVALUATING CREEP TESTS. Vollath, D. (Kernforschungszentrum, Karlsruhe, Ger.). Ber. Deut. Keram. Ges.; 50: No. 2, 31-32(1973). (In Germany).

A better method is described for evaluating creep tests, particularly compressive creep tests such as are carried out on ceramic materials. The method is suitable for direct use with digital computers. As an example, this computer method is applied to a creep test on UO_2-PuO_2. (GE)

8617 PREPARATION AND X-RAY INVESTIGATION OF URANIUM NITRIDES UN_x; $x > 1.75$. Berthold, H. J.; Hein, H. G.; Reuter, H. (Technische Univ., Hanover). Ber. Deut. Keram. Ges.; 50: No. 4, 111-114(1973). (In German).

The reaction of UN or UN_x ($x < 1.76$) with N_2 or NH_3 at pressures up to 200 atm and temperatures between 400 and 600°C leads to nitrides of the maximum composition $UN_{1.83}$ (N_2) or $UN_{1.86}$ (NH_3). The high-temperature ammonolysis of UF_4 in a stream of NH_3 at 900°C yields a stable nitride of the composition $UN_{1.80 \pm 0.02}$ with an ordered cubic primitive structure ($\alpha = 10.605 \pm 0.001$ Å). The same cubic primitive lattice, however disordered and highly distorted, also possess the above-mentioned nitrides UN_x ($x > 1.76$) which are obtained by nitriding UN_x ($x < 1.76$). The assumption that these nitrides would have the CaF_2 structure with a lattice constant of about 5.3 Å is not justified. The cubic primitive phase is called "γ phase." (GE)

8618 SYSTEM MOLYBDENUM-TUNGSTEN-CARBON. Gorshkova, L. V.; Telegus, V. S.; Shamrai, F. I.; Kuz'ma, Yu. B. (Lvov State Univ.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 3, 74-76(Mar 1973). (In Russian).

The phase composition of the system Mo-W-C was studied by means of x-ray and microstructural analysis in the region of 50 at. % C, and the isothermal section at 1000°C was plotted. At that temperature, solid solutions on Mo_2C and WC base are stable carbide phases. Tungsten solid solution in Mo_2C with ordered rhombic lattice (of $\xi = Fe_2N$ type) is arranged along the 32 at. % C isoconcentrate and extends the ternary system to 60 at. % W. Molybdenum solubility in WC is negligible. (auth)

8619 PARTIAL THERMODYNAMIC PROPERTIES OF ZIRCONIUM CARBIDE IN THE REGION OF HOMOGENEITY. Andrievskii, R. A.; Khromonozhkin, V. V.; Khromov, Yu. F.; Alekseeva, I. S.; Mitrokhin, V. A. Dokl. Akad. Nauk SSSR; 206: No. 4, 896-898(1 Oct 1972). (In Russian).

The partial pressure of carbon vapor in the region of homogeneity of ZrC was determined using hot-pressed samples of ZrC and lamp black that had been labeled with ^{14}C. The resulting compositions had the formulas $ZrC_{0.63}$, $ZrC_{0.67}$, $ZrC_{0.84}$, $ZrC_{0.89}$, $ZrC_{0.92}$, and $ZrC_{0.95}$, were single-phase, and contained less than 0.05 wt % free carbon. Analytical expressions of log p vs 1/T were obtained for each of these six compositions. The partial heats of sublimation were strongly dependent on concentration. (KSW)

Metals and Alloys

Refer also to abstracts 8059, 8550, 8599, 8607, 9986, and 10492.

8620 (CONF-720223-) HIGH TEMPERATURE MATERIALS. Proceedings of the symposium on Materials Science Research, Hyderabad, February 21-23, 1972. (Department of Atomic Energy, Bombay (India). Chemistry and Metallurgy Committee). 1972. 542p.

From symposium on materials science research; Hyderabad, India (February 21 1972).

Thirty-seven papers were presented at the symposium. A separate abstract was prepared for each of 17 papers. The remaining papers are not in the scope of NSA. (JRD)

For abstracts of individual papers see: 8576-8582, 8630-8632, 8650-8653, and 8705-8707.

8621 COMPOSITE MATERIALS: TESTING AND DESIGN. (Second Conference). Conference held at Anaheim, CA, April 20-22, 1971. ASTM special technical publication 497. Philadelphia; American Society for Testing and Materials (1972). 616p. (ASTM-STP-497; CONF-710403--). $36.50.

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

Thirty-six papers were presented at the conference. A separate abstract was prepared for each of eighteen papers. Eighteen papers were considered not in scope of NSA. (JRD)

For abstracts of individual papers see: 8744-8747, 8769, and 8802-8814.

Corrosion and Erosion

Refer also to abstracts 8565 and 8577.

8622 (CEA-CONF-2192) VAPOR DEPOSITION OF REFRACTORY METALS APPLIED TO THERMOELECTRIC CONVERSION. Performance of Deposits Obtained by Reduction of Fluorides at High Temperature and Low Pressure. Faron, R.; Bargues, M.; Gillardeau, J.; Hasson, R.; Dejachy, G.; Durand, J. P. (Societe des Usines Chimiques, Pierrelatte (France); Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1971. 23p. (In French). (CONF-720613-5) Dep. NTIS (U. S. Sales Only) $3.25.

From 3rd international conference on thermionic electrical power generation; Julich, Federal Republic of Germany (5 Jun 1972).

For the manufacture of thermoelectric emitters, the growth of deposits of refractory metals by the reduction of the metallic fluorides at high temperature and low pressure was studied. It was thus possible to obtain deposits from the vapor that were of

high quality, epitaxic on the metallic substrate, very pure, adherent, and compact. A process for making crystal planes of high density appear on the surface was demonstrated. The results of the examinations of these crystalline growths by metallography, scanning microscopy, Castaing microprobes, and radiocrystallography are described, as well as the particular technology necessary for the reduction of the gaseous metal fluorides at high temperature and low pressure. (tr-auth)

8623 (CONF-721104-5) CORROSION RESISTANCE OF Ni–Cr STAINLESS STEEL IN HIGH TEMPERATURE FLOWING WATER: CORROSION AND STRESS-CORROSION CRACKING BEHAVIOR IN HIGH-TEMPERATURE WATER. Ito, G.; Shimizu, Y.; Ishihara, T.; Fujii, T. (National Research Inst. for Metals, Tokyo (Japan)). [nd]. 23p. (In Japanese). Dep. NTIS (U.S. Sales Only).

From INCO power conference; Kyoto, Japan (28 Nov 1972).

Results of out-of-pile tests are presented concerning the corrosion behavior of Cr–Ni stainless steels in pure water at high temperatures. The general corrosion rate of Cr–Ni stainless steels under the testing condition simulating the environment in water cooled power reactor was studied emphasizing the effects of dissolved oxygen, flow rate of water, and testing temperature. Stress-corrosion cracking of stainless steel in high temperature water was also studied. The effects of alloying composition, impurities, heat treatment, structure, and welding of steels on the susceptibility to stress corrosion cracking were examined. Cracking behavior of piping system by internal pressure was also studied. (auth)

8624 (ORNL-TM-4105, pp 2.1-2.52) STEAM GENERATOR AND HEAT EXCHANGER MATERIALS. May 1973.

In fuels and materials development program quarterly progress report.

Research devoted to development of improved methods of fabricating and inspecting components for LMFBR and for determining properties of reactor materials is reported. Results are presented on steam-side/water-side corrosion, stress corrosion, materials corrosion in chloride loop, tube stress testing, welding steam generator and heat exchanger materials, mechanical properties of boiler materials, and nondestructive test development. (JRD)

8625 (RD/B/N-2412) COMBUSTION OF LIQUID SODIUM IN AIR. Newman, R. N. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Nov 1972. 22p. Dep. NTIS (U.S. Sales Only) $3.25.

An experimental study was made of small-scale sodium pool fires burning in air, particular attention being paid to ignition temperatures, pool temperatures, and to the principal burning characteristics. Ignition for stirred pools was found to occur at temperatures appreciably below the limit of 320°C found for a static pool. Three combustion modes were observed and are discussed. (UK)

8626 (WARD-3045-T-1-7) SODIUM TECHNOLOGY PROGRAM PROGRESS REPORT FOR THE PERIOD ENDING OCTOBER 31, 1972. Ray, W. E. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div). Jan 1973. Contract AT(11-1)-3045 104p. AT $5.45.

Research progress is reported on wear rates of contacting materials in sodium, self welding of FFTF materials, FFTF component materials compatibility, properties of FFTF coating materials for use in sodium environments, and sodium loop exposure of FFTF materials. (JRD)

8627 (WARD-3045-T-1-10) SODIUM TECHNOLOGY PROGRAM. Progress Report for the Period Ending January 31, 1973. Ray, W. E. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). Mar 1973. Contract AT(11-1)-3045. 111p. AT $5.45.

Activities in programs to measure friction coefficients and wear rates for FFTF materials are reported along with results of experiments on self-welding properties of FFTF materials. Experiments are also described which were conducted to gain information on stability of reactor materials in liquid metal cooling circuits. Other work on mechanical properties of coatings and wear resistant surfaces considered for FFTF applications is described. (JRD)

8628 ELECTROLYTIC MAGNETIC Co-BASE ALLOYS. II. Corrosion Resistance. Rachinskas, V. S.; Matulis, Yu. Yu. (Inst. of Chemistry and Chemical Tech., Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 2: 69-81(1972). (In Russian).

Magnetic properties, chemical composition, mixed corrosion potential (φ_0), and corrosion rate (K) in 1% H_2SO_4 of Co–W alloys obtained under various electroplating conditions were determined. The K of magnetic alloys Co–W, Co–W–P, and Co–Ni–P depending on the nature of metal of the first layer (Cu, Cu–Zn, Ag, Ni–P) and of the protective layer (Ni–P, Cr, Pd) was investigated under various testing conditions. It was established that K of magnetic Co–W alloys decreases, φ_0 becomes more positive, and W content on the coatings increases with the rise of temperature and pH of the electrolytes and with the decrease of current density. It was found that metal of the first layer had no influence on the K of magnetic alloys in 1% H_2SO_4 and in H_2O. The thin protective layers of Cr and Ni–P alloy with high porosity do not protect magnetic layers from corrosion in H_2O. The Pd films reduce K of Co–W alloys but they have low resistance to H_2O. (auth)

8629 INTERNAL OXIDATION OF NICKEL–ZIRCONIUM AND NICKEL–ZIRCONIUM–SILICON ALLOYS. Shabalin, I. N. Tr., Mosk. Inst. Elektron. Mashinostr.; No. 8, 49-55(1970). (In Russian).

Results are given from a study of the internal oxidation (for periods up to 10 h) of single-phase Ni–Zr 0.21% and Ni–Zr 0.16%–Si 0.18% alloys (electron-beam melted) at 900, 1050, and 1200°C. The activation energies for the oxidation of these alloys are 60 and 92 kcal/mole O, respectively. The depth of the internal oxidation layer has a parabolic relationship to the duration and an exponential relation to the oxidation temperature. Internal oxidation can cause a reduction in the elongation and considerable reductions in UTS. (Metals Abstr.)

8630 HIGH-TEMPERATURE MATERIALS FOR SODIUM-COOLED FAST BREEDER REACTORS: REVIEW OF THEIR COMPATIBILITY PROBLEMS. Gnanamoorthy, J. B. (Bhabha Atomic Research Centre, Trombay, India). pp 159-172 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

The significance of liquid sodium as a coolant in nuclear fast breeder reactors, the three basic mechanisms of corrosion by liquid metals and the general corrosion testing procedures are described briefly. The special corrosion and compatibility problems connected with the use of various types of materials in liquid sodium are examined. The transport of carbon in liquid sodium resulting in carburization or decarburization of the structural materials is discussed in detail. Austenitic stainless steels are generally considered to be reasonably resistant to sodium containing not more than 10 ppM of oxygen, for temperature up to 600°C. Ferritic steels are also found to be satisfactory, provided they have sufficient alloying additions such as Cr and Mo to stabilize the carbon present in them. If the sodium temperature is to be further raised to 650 to 750°C (to realize considerable reductions in power costs), the sodium technology has to be extended in the areas of fuel cladding and steam-generator materials to develop alloys based on special metals such as Nb and V. Stress-corrosion tendencies in the water-side of the heat exchangers and the steam generators have to be effectively checked by the design and development of the construction materials. (auth)

8631 OXIDATION CHARACTERISTICS OF ZIRCONIUM AND ZIRCALOY-2 IN OXYGEN BETWEEN 450 AND 750°C. Gadiyar, H. S.; Phadnis, S. V.; Balachandra, J. (Bhabha Atomic Research Centre, Trombay, India). pp 185-207 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

Kinetic curves of oxidation of crystal-bar zirconium were analyzed in the temperature range 450 to 750°C in oxygen at a pressure of 100 torr, using electrothermogravimetric balance. A near-linear oxidation behavior has been observed during the initial 5 to 10 minutes of oxidation, followed by a parabolic film growth. This initial rapid growth is attributed to high stresses in the oxide. A low activation energy of the order of 12 kcal/mole is obtained between 450 and 650°C for this initial state of oxidation. The parabolic growth rate has been explained on the basis of diffusion through the thickening oxide by anion vacancy mechanism. Cracking of the oxide film at oxide/oxidant interface occurs at temperatures of 700 to 750°C. Activation energy for the rate-controlling mechanism of the parabolic rate growth has been observed to be 34.1 ± 3 kcal/mole in the temperature range 450 to 600°C. A comparison of the oxidation rates of crystal bar Zr, Kroll Zr, and Zircaloy-2 at 450, 600 and 750°C has been included in the study. Kroll Zr shows slightly higher oxidation rates compared with purer crystal bar Zr, while rates on Zircaloy-2 are higher than both. These variations are discussed on the basis of the presence of impurities or alloying additions in zirconium. Estimates of oxygen solubility in the metal between 600 and 750°C have shown that the correction factor will not greatly influence the oxidation kinetics. (auth)

8632 PRINCIPLES OF DEVELOPING HIGH-TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS. Keskar, A. R. (Indian Space Research Organization, Trivandrum). pp

209-219 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

At high temperatures, the common refractory metals undergo severe oxidation. In addition, the oxides melt and/or evaporate exposing fresh metal to the environments. To overcome this drawback to their high temperature applications, considerable research effort has been devoted to the development of suitable protective coatings. However, these developments have been empirical. The oxidation behavior of unprotected refractory metals is discussed and the principles underlying the developments are rationalized. (auth)

8633 USE OF CHLORINATED RUBBER IN MODERN ANTI-CORROSION COATINGS. Sayers, R. Plast. Resinas; 13: No. 69, 4-18(1971). (In Spanish).

The use of chlorinated rubber for thick protective coatings is considered from the economic point of view, and in particular the cost is calculated for using such coatings for protection of road tankers carrying aggressive chemicals and for steel equipment at dye works and other chemical factories. Methods of application, the influence of various primers, and methods of surface preparation on protective properties are described. Examples illustrate the wide use of these coatings in other branches of industry, including atomic reactors and ships. (Corrosion Abstr.)

Preparation and Fabrication

Refer also to abstracts 8552, 8554, 8556, 10038, and 10051.

8634 (ORNL-TM-4105, pp 5.1-5.46) WELDING DEVELOPMENT: FBR COMPONENTS. May 1973.

In fuels and materials development program quarterly progress report.

Welds are being prepared in type 316 stainless steel with a number of commercial type 16-8-2 filler metals. In a number of cases, the usability of type 16-8-2 bare wire is limited by poor wetting action; special techniques can, however, produce welds of acceptable quality. Mechanical properties tests on the series of welds with intentional ferrite content variations show a marked decrease in creep-rupture ductility with increased ferrite content in the range of 0 to 15% ferrite. Mechanical properties tests are continuing on FFTF vessel test welds. It is noted that the deformation resistance of the weld metal is different in different directions; transverse specimens are significantly stronger than longitudinal all-weld-metal specimens tested in the 900 to 1200°F temperature range. The lowest observed total strain for any all-weld-metal creep specimen of the CRE-type 308 stainless steel is 13%. Creep tests have been performed on an array of specimens taken from a FFTF vessel test weld cross section. Heat-affected zone specimens had longer rupture times and lower total elongation values than as-received base metal specimens. Specimens which were part weld metal and part heat-affected zone exhibited widely scattered properties depending upon the relative amounts of the ductile, soft weld metal and the less-ductile but strong heat-affected zone material contained in the gage section. Microstructural studies on type 308 welds showed that the kinetics of the ferrite–sigma transformation varied greatly from weld to weld and within a single weld, where the transformed regions tended to occur in patches. In prerupture crack, formation has been associated with austenite–sigma phase interfaces. The CRE welds, however, do not exhibit such cracking and the ultimate fracture is of a ductile shear nature. The application of magnetic etching in the detection of magnetic microstructural constituents is continuing. Strain-induced martensite can readily be detected in type 304 tensile specimens. (auth)

8635 (REG/G-1-34(12-72)) CONTROL OF ELECTROSLAG WELD PROPERTIES. (Directorate of Regulatory Standards (AEC), Washington, D.C.). 28 Dec 1972. 3p. DRS, Washington, DC Free.

This regulatory guide applies to light-water reactors and describes an acceptable method for implementing requirements with regard to control of weld properties when fabricating electroslag welds for nuclear components made of ferritic or austenitic materials. (LMT)

8636 PROPERTIES OF WELDED JOINTS IN MOLYBDENUM ALLOYS ALLOYED WITH CARBON, ZIRCONIUM, AND TITANIUM. Alekseenko, G. N. (Welding Inst., Kiev); Nerodenko, M. M.; Biryukova, T. A.; Mal'tsev, M. V.; Shchukin, A. A. Avtomat. Svarka; 25: No. 9, 20-21(1972).

The effects of zirconium or titanium on the properties of welded joints in a molybdenum–carbon alloy have been investigated. It was established that adding zirconium improves their strength and ductility. It was also found that the addition of zirconium reduces the grain size in the weld metal and the heat affected zone and is conducive to the formation of a well-defined substructure, improving the strength and ductility of welded joints. The addition of titanium has less effect on the ductility of welded joints in molybdenum–carbon alloys. (JRD)

8637 ELECTROLESS TERNARY Ni ALLOY PLATING. Val'syunene, Ya. I.; Prokopchik, A. Yu.; Kimtene, D. P.; Vilutene, V. A. (Inst. of Chemistry and Chemical Tech., Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. B; 2: 3-16(1972). (In Russian).

The conditions for electroless Ni–Mo–B, Ni–W–B, Ni–Fe–B, and Ni–Re–B plating from alkaline solutions, containing $NiCl_2$, ligand–ethylenediamine or ethylenediamine and tartrate, salt of metal (Na_2MoO_4, K_2WO_4, $FeSO_4$ and $NaReO_4$), reducing agent $NaBH_4$, and stabilizer $K_2S_2O_5$ are investigated. In the optimal conditions Ni–Mo–B alloy contains 7 wt.% Mo, Ni–W–B alloy 2 to 6 wt.% W, Ni–Fe–B alloy 40 wt.% Fe, and Ni–Re–B alloy 20 wt.% Re. B content in the alloys is within 3 to 7 wt.%. Ni–Mo–B, Ni–W–B, Ni–Re–B are nonmagnetic, but Ni–Fe–B has ferromagnetic properties. The coatings of the alloys are hard (up to 1500 kg/mm^2 by Vickers) and have few pores. (auth)

8638 EXPERIENCES IN WELD CRACKING DURING NUCLEAR PLANT CONSTRUCTION. Dickinson, F. S.; Nichols, R. W. pp v of Cracking and Fracture in Welds. Tokyo; Saikon Publishing Co. Ltd. (1972).

From 1st international symposium on cracking and fracture in welds; Tokyo, Japan (8 Nov 1971).

During construction of the chemical process plant and various types of nuclear reactor operating in the UK, many types of weld cracking have been observed. The reasons and methods used to overcome the difficulty and recurrence prevention are surveyed. Experience covering the construction of austenitic stainless steel up to 2 inches in thickness is reviewed, where the principal problem was hot cracking due to particular weld chemistry required for corrosion reasons. Construction of large pressure vessels up to 20 meters dia and 100 mm thickness in the gas-cooled reactor program is of special interest, and important for emphasizing the value of carefully controlled procedure tests and non-destructive testing techniques to control weld quality. The welding of heat exchanger shells and steam drums is used to illustrate problems arising from difficult weld geometry and the use of steels prone to re-heat cracking. The use of internal bore welding for tube to tube plate attachment provides an example of the care required and techniques found necessary to avoid hot cracking in austenitic stainless steels and the particular difficulties to prevent crater cracks. The value of various forms of non-destructive testing are presented and the relative values discussed. The problem of lamellar tearing has been internationally debated and our experience in the construction of heavily restrained carbon manganese steel joints is of interest. A clear understanding of the findings from ultrasonic testing is essential in identifying this defect and the dangers arising from its application without precise reference standards is highlighted. (auth)

8639 IMPROVEMENTS IN THE FABRICATION OF FUEL ELEMENTS. (to Centre de Recherches Metallurgiques). Belgian Patent 782,079. 13 Apr 1972. 5p. (In French).

For fabrication of fuel cans that are to be used in fast reactors, the use of an alloy satisfying the following conditions: 8% ≤ Cr ≤ 25% and 0% ≤ Ti ≤ 7%, the rest being constituted principally of Fe with its usual impurities, is described. In addition, the use of one or more of the following elements in the proportions indicated is mentioned: Al from 0 to 6%, V from 2 to 7%, Si from 2 to 7%, Mo from 0 to 3%, and one or more rare earths (from 0 to 0.5% for each rare earth). Also described is the use of one or more of the stable oxides listed below dispersed in the metallic matrix: Al_2O_3 from 0 to 8%, MgO from 0 to 8%, TiO_2 from 0 to 8%, and Y_2O_3 from 0 to 8%. (tr-auth)

8640 ELECTROLYTIC PRODUCTION OF MOLYBDENUM FROM A MOLTEN CHLORIDE BATH USING MOLYBDENUM DIOXIDE–CARBON ANODES. Suri, A. K.; Gupta, C. K. (Bhabha Atomic Research Centre, Bombay). J. Less-Common Metals; 31: No. 3, 389-392(Jun 1973).

An investigation was made of the use of oxide–carbon anodes in the extraction of Mo from a fused KCl–K_3MoCl_6 electrolyte under an inert atmosphere. The influences of operating voltage, cathode current density, electrolyte temperature, and bath composition on the quality and current efficiency of the electrodeposited Mo were examined. Optimum operating conditions were determined to be: 0.2 to 0.4 V, 450 A/ft^2, 950°C, and 7 wt.% Mo. Impurity content was ≤20 ppM for most elements, and hardness of melted buttons was 150 VPN. (DLC)

8641 PLUTONIUM: PROBLEMS AND POSSIBILITIES. Rippon, S. Arch. Energiewirt.; 27: No. 5, 241-250(1973). (In German).

A review is given on the possibilities for creating plutonium, the amount of available plutonium, its storage, its further uses, its costs and the economical considerations for the western world, in particular, for Great Britain, USA, and the Common Market countries. (GF)

8642 APPLICATION OF NUCLEAR HEAT PRODUCING REDUCTION GASES FOR THE FABRICATION OF IRON SPONGES. Chaussy, L. Aachen; Technische Hochschule (1971). 88p. (In German).

Thesis.

The application of nuclear energy in the reduction of iron ore requires high temperature heat exchangers for the endothermic production of the reducing gases. Three concepts of an allothermal vaporizer were suggested, and the specific conversion efficiency was calculated; first process: the nuclear reactor cooling medium helium (1200°C, 40 atm) gives off its heat through a ceramic wall to a stack of coke; in both other processes, a metallic regenerative liquid (lead) is put between the consumer and the nuclear reactor. The conversions obtained are unexpectedly high. Under best physical conditions, the heat-production capacity is about 10^6 kcal/h × m^3. The problem of transferring the heat with a liquid storing medium is investigated. The chemical heat pump or the connection between the heat and transport of oxygen are of particular advantage. The reducing processes are subdivided into: (1) with gas regeneration and washing, (2) with gas regeneration and without washing, (3) with neither gas regeneration nor washing. The regeneration of the reducing gases saves the energy costs using dry coal with a high degree of carbonization. (GF)

8643 STRENGTH OF WELDS IN HARD ALLOYS OF TUNGSTEN CARBIDE–COBALT TYPE IN RELATION TO THICKNESS OF INTERMEDIATE LAYER AND TECHNOLOGY OF ITS DEPOSITION. Mukha, I. M.; Dovbishchuk, M. N.; Belilovets, A. D.; Vyshnevskii, V. S. Elektron. Obrab. Mater.; No. 5, 26-30(1972). (In Russian).

The technological conditions required for the deposition of intermediate Ni and Co layers for the diffusion welding of WC–Co alloys in a glow discharge are considered, together with the effects of the thickness of the interlayer on the strength of the weld. Interlayers of Ni and Co in the form of powders may be conveniently used for flat-ground hard alloy parts of the kind envisaged; for parts with a complex surface thin films obtained by vacuum evaporation are better. The best thickness is 4000 to 8000 Å. (Metals Abstr.)

8644 PROCESS FOR PRODUCING A FINE-GRAINED 316 STAINLESS STEEL TUBING CONTAINING A UNIFORMLY DISTRIBUTED INTRAGRANULAR CARBIDE PHASE. Reimann, G. A.; Martin, W. R. (to United States Atomic Energy Commission). U. S. Patent 3,723,193. 27 Mar 1973. Filed date 27 Oct 1970. 6p.

A fine-grained metal alloy having a second phase randomly distributed throughout the structure as fine discrete particles is prepared by initially heating the alloy to a sufficiently high temperature to place essentially all of the second phase forming material in the alloy into solution and thereafter subjecting the alloy to repetitive heat treatments, interspersed with cold work, to cause recrystallization and partial precipitation of said second phase material at the lowest temperature commensurate with the degree of cold work. In one embodiment, austenitic stainless steel Type 316 tubing having a grain size of ASTM-14 (2.4 to 2.8 microns) and a fine randomly-distributed carbide precipitate (100 to 1000 angstroms) was prepared. Owing to improved metallurgical properties these stainless steels are suitable as a cladding for liquid metal fast breeder reactor fuel elements. (Official Gazette)

8645 METHOD OF AND APPARATUS FOR WELDING AN END PLUG ONTO A NUCLEAR FUEL ELEMENT. Fink, R. W.; Boyko, E. S. (to Westinghouse Electric Corp.). U. S. Patent 3,725,635. 3 Apr 1973. Filed date 20 Aug 1971. 12p.

Welding methods and apparatus are described for bonding a metallic end plug into an end of a metallic fuel tube or rod for a nuclear reactor. Defects in the weld joint between the fuel tube and end plug are substantially reduced by arc welding in a chamber filled with an inert gas, disposing the welding electrode directly over the joint to be welded, deflecting plasma produced during the welding away from the body of the fuel tube, and directing the plasma into the joint. (Official Gazette)

8646 PRODUCTION OF STRANDED TUNGSTEN FILAMENT WIRE FOR THE VACUUM METALLIZING INDUSTRY. Davidson, H. I. Wire J.; 5: No. 3, 51-58(Mar 1972).

Tungsten is used for vacuum metallizing filaments because the internal grain structure withstands repeated heating and because most metals wet W easily. Ore is treated to produce ammonium paratungstate, then atmosphere reduced to blued oxide, mixed with additives and further reduced in H to W metal powder. The powder is compacted to form a rectangular ingot, which is then sintered at 3000°C and swaged into round bars. Filaments are produced by drawing the rod through a WC die and twisting individual wires into strands. (Metals Abstr.)

8647 NICKEL PLATING BATHS CONTAINING AROMATIC SULFONIC ACIDS. Lundquist, J. R.; Stromatt, R. W. (to United States Atomic Energy Commission). U. S. Patent 3,726,768. 10 Apr 1973. Filed date 23 Apr 1971. 8p.

The stress of nickel deposits from plating solutions can be altered from tensile to near zero, and also to compressive stress by adding to nickel plating baths, such as those containing nickel sulfate and nickel bromide, amino naphthalene di- and tri-sulfonic acids, and naphthol disulfonic acids and their salts, such as, for example, 3-amino-2,7-naphthalenedisulfonic acid, and 2-naphthol-6,8-disulfonic acid, and their sodium and nickel salts. When the nickel salts of the above sulfonic acids are used as plating solutions rather than in the small amounts required as additive, bright or semibright, adherent, and nonporous nickel deposits are formed and the stress of such nickel deposits range from approximately zero psi to −26,000 psi (compressive). Similar results were also obtained with the nickel salts of benzenesulfonic acid, benzenedisulfonic acids, naphthalenesulfonic acids, and naphthalenedisulfonic acids. Preferably, all plating solutions contain nickel bromide. These plating solutions can be used for electroplating nickel on any substrate, including uranium. (auth)

8648 PROCESS FOR DELUBRICATION, PRESINTERING, SINTERING, AND RAPID COOLING IN A VACUUM INDUCTION FURNACE. Hallemeir, J. F. (Leybold-Heraeus, Inc., Monroeville, PA). Int. J. Powder Met.; 9: No. 2, 77-85(Apr 1973).

Delubrication, presintering, and sintering are major steps in the manufacture of many products in the powder metallurgy field. The quality of the final product, to a great extent, depends on the quality, accuracy, and reliability of the sintering equipment used. A vacuum induction furnace for delubrication, presintering, sintering, and rapid cooling is described which offers the possibility of delubricating the charge under vacuum and protection or reactive gas atmospheres at reduced pressures and to sinter the material in the same furnace, eliminating charge handling and transfer between the delubrication and sintering processes. (auth)

8649 SINTERED MARAGING ALLOYS. Mukherjee, J. K. (National Metallurgical Lab., Jamshedpur, India). Int. J. Powder Met.; 9: No. 2, 95-100(Apr 1973).

The age hardening behavior of sintered substituted maraging alloys are compared with the conventional 18 Ni–8 Co–4 Mo compositions. The sintered compacts gave peak hardness lower than the wrought alloys although the strengthening phases (Ni_3Mo, Fe_2Mo, Ni_3Ti and Fe_2Ti) were found to be the same. (auth)

8650 PRODUCTION OF REFRACTORY METALS BY ALUMINOTHERMIC REDUCTION OF THEIR OXIDES. Mukherjee, T. K.; Bose, D. K.; Gupta, C. K. (Bhabha Atomic Research Centre, Trombay, India). pp 221-234 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

The aluminothermic reduction route for the production of refractory metals from their oxides has received attention recently because of the low cost of aluminum, its availability in pure form, ease of handling, and low equivalent weight. High reduction efficiency is obtainable by this process but the product always needs a post-reduction refining treatment to remove the residual aluminum by either pyro-vacuum treatment and electron beam melting or by fused salt electrorefining. The aluminothermic process as applied to production of refractory metals such as V, Ta, Nb, Mo, and W is reviewed with special reference to investigations carried out at the Metallurgy Division, BARC. (auth)

8651 DISPERSION HARDENING IN MOLYBDENUM AND ITS EVALUATION BY HOT-HARDNESS TEST. Sinha, K. K. (Bhabha Atomic Research Centre, Trombay, India); Hammond, J. P. pp 445-459 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

Results of experiments conducted to produce dispersions of refractory oxides of submicron particle size are presented, the emphasis being on development of a technique that can be applied to refractory metals such as Mo. Results of hot-hardness tests on as-sintered pellets point to the influence of density and exhibit the

superiority of the colloidal process over that of co-precipitation. Results of comparison of Mo–ThO_2 and Mo–ZrO_2 dispersions with sintered Mo compacts containing no dispersions, indicates the strengthening caused by fine dispersions without any primary working. The strength advantages of dispersion hardened systems are likely to be more apparent at temperatures above 1000°C when the effect of alloy or strain hardening is not likely to persist. (JRD)

8652 NEW APPROACH TO DENSIFICATION OF HIGH-TEMPERATURE MATERIALS. Khanna, R. P.; Bhalla, A. K.; Menon, U. G. K. (Defense Metallurgical Research Lab., Hyderabad, India). pp 499-506 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

A new concept of pre-sintering coupled with explosive compaction is described. The pre-sintering of compacts before explosive loading imparts a degree of green strength necessary to withstand the explosive shocks. Application of this technique to tungsten and molybdenum resulted in compacts at 95 to 96% of the theoretical densities. X-ray diffraction patterns of the compacted mass showed the presence of line-broadening effect. This indicates that explosive compaction is a cold-working process. The defects introduced have a tendency to anneal out, resulting in recrystallization of the shocked specimen at lower temperatures. This was confirmed when explosively shocked compacts were annealed at 1450°C for one hour. The appearance of equi-axed grains when examined under optical microscope reveals that residual stresses developed during compacting process lead to activated sintering. The technique appears powerful and promising for fabricating materials needed in high-temperature applications. (auth)

8653 SELECTION OF SERIES OF ALLOYING ELEMENTS FOR SYNTHESIS OF TITANIUM ALLOYS. Dhindaw, B. K. (Indian Inst. of Tech., Kharagpur). pp 507-515 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

Use of the periodic system of elements and physico-chemical analysis for the generalization of the characteristics of the mechanical properties of Ti-base alloys is discussed. The distribution of elements in groups based on properties likely to effect alloy strengthening and on properties likely to be detrimental in Ti alloys is determined. The distribution classification is used to select elements for their contribution to desired alloy properties. Optimization of properties can be done by cybernetics. (JRD)

8654 ROLLING OF BERYLLIUM IN A VACUUM. Smirnov, V. S.; Yakovlev, V. P.; Aleksandrov, A. A. Tsvetn. Metal.; No. 3, 56-57(Mar 1973). (In Russian).

Beryllium possesses a high heat conductivity that affects the rate of rolling of preheated Be stock on cold rollers, which in turn affects the deformability of Be during rolling in a vacuum (5×10^{-5} mm Hg). (tr-auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 8806, 8812, 9836, 9898, 10139, and 10477.

8655 (AD–752082) DEFORMATION AND SOLID-SOLUTION STRENGTHENING OF BCC TITANIUM–VANADIUM ALLOYS. Annual Report. Paton, N. E.; Williams, J. C. (North American Rockwell Corp., Thousand Oaks, Calif. Science Center). 7 Aug 1972. Contract N00014–71–C–0363. 25p. NTIS.

The purpose of the study was to investigate systematically the effects of oxygen concentration on the deformation of Ti–V alloys and to study the combined effects of the substitutional V additions and interstitial oxygen additions on the thermal and athermal components of the flow stress and on dislocation arrangements. The effect of oxygen content on the critical resolved shear stress of Ti–40 V single crystals was evaluated as a function of temperature. (auth)

8656 (AD–752930) SOLUTIONING AND AGING REACTIONS AND THEIR EFFECT ON HARDNESS AND MICROSTRUCTURE IN SOME NIOBIUM-BASE ALLOYS. Birla, N. C.; Hoch, M. (Cincinnati Univ., Ohio. Dept. of Materials Science and Metallurgical Engineering). Sep 1972. Contract DAHC04–69–C–0016. 142p. (THEMIS–72–31; AROD–T–4–50–E). NTIS

A study was made to investigate the solutioning and aging reactions and their effects on microsstructure and hardness in twenty-four experimental columbium-base alloys, involving Nb–C, Nb–Si–C, Nb–15Hf–C, Nb–15Hf–C–Si, Nb–33Hf–C and Nb–33Hf–C–Si systems. The aging reactions in the Nb–15Hf–C, Nb–15Hf–C–Si, and NB–33Hf–C–Si alloys are characterized by precipitation of the complex monocarbide (Nb, Hf) (C, O, N) phase. Replacement of some of the carbon by silicon in the Nb–15 Hf–1C alloys raises the overaging temperature from 800 to 1000°C and leads to strength retention for longer times than the alloys that contain carbon only. (auth)

8657 (AD-753572) PHYSICAL PROPERTIES OF RARE EARTH–COBALT MAGNET MATERIALS. Technical Report, 1 January–30 June 1972. Chipman, D. R.; Jennings, L. D. Jr. (Army Materials and Mechanics Research Center, Watertown, Mass.). Sep 1972. 17p. (AMMRC-TR-72-30). NTIS.

Studies were undertaken to define the changes in properties that occur in rare earth–cobalt magnet materials in the temperature range up to 1000°C. A wide range of types of behavior of the time dependence of the magnetization at relatively low temperatures is observed. It is shown that the simple mechanisms for this time dependence do not apply. Unusual types of irreversibility are displayed, and these may be useful in applications, e.g., in some cases it would be advantageous to remagnetize after a number of hours at the operating temperature. X-ray measurements were carried out at high temperatures. Although some lattice parameter values were determined, it was not possible to gain much structural information because of rapid sample deterioration. Details of the mechanism of the deterioration are reported. (auth)

8658 (AD-753615) ELASTIC CONSTANTS OF POLYCRYSTALLINE VANADIUM–IRON ALLOYS. Donegan, J. Jr. (Naval Postgraduate School, Monterey, Calif.). Sep 1972 61p. NTIS.

Thesis.

Polycrystalline alloys of iron in vanadium up to 15.32 at. % were prepared principally by arc melting. In order to obtain the elastic constants and investigate the possibility of the existence of an elastically isotopic alloy, ultrasonic measurements were made. These measurements determined the longitudinal and transverse wave velocities in the 10- to 30-MHz range at room temperature. The resulting longitudinal modulus increased with alloying whereas the shear modulus remained roughly constant although the data are somewhat scattered. These data are interpreted to show that the shear constants vary through alloying in a manner consistent with the results of other experiments and that the results are consistent with an s^1d^{n+1} electronic configuration in the transition metals. The existence of an isotropic alloy is indicated for alloys with electron to atom ratios lower than vanadium rather than for the alloys measured. (auth)

8659 (AD-754760) OXIDATION AND HOT CORROSION OF Ni–Cr- AND CO–Cr-BASE ALLOYS CONTAINING RARE EARTH OXIDE DISPERSIONS. Final Report, 3 December 1971–3 December 1972. Wright, I. G.; Wilcox, B. A.; Jaffee, R. I. (Battelle Columbus Labs., Ohio). 30 Jan 1973. Contract N00019-72-C-0190. 157p. NTIS.

The effects of dispersions of the oxides Y_2O_3, ThO_2, and Al_2O_3 on the oxidation and hot corrosion of Ni–20% Cr-base alloys, and of dispersions of Y_2O_3 on the oxidation and hot corrosion of Co–Cr-base alloys have been studied. Up to 1100°C, dispersions of Y_2O_3, ThO_2 and possibly Al_2O_3 have very similar effects on the oxidation of Ni–20% base alloys. (auth)

8660 (AD-754775) PREPARATION AND PROPERTIES OF RARE EARTH COMPOUNDS. Final Technical Report, 3 June–31 December 1972. Wood, V. E.; Austin, A. E.; Brog, K. C. (Battelle Columbus Labs., Ohio). 31 Dec 1972. Contract DAAH01-70-C-1076. 41p. NTIS.

The principal portion of the present report consists of a survey of proposed applications of materials having both magnetic and ferroelectric ordering and/or displaying magnetoelectric coupling effects, together with an assessment of the extent to which any of these applications is feasible using presently known materials. Novel, and in some ways superior, devices of the "signal-processing" type (such as amplitude or phase modulators) operating at frequencies from microwave to visible are possible in principle, although considerable further experimental work is necessary before it can even be shown that effective specific devices can be designed. Magnetoelectric memory devices do not at present seem very feasible. A brief survey of other work on this program is also included. (auth)

8661 (AERE-R-7172) LOW-TEMPERATURE PROPERTIES OF TRANSURANIC METALS. Sutcliffe, P. W. (Atomic Energy Research Establishment, Harwell (England)). Aug 1972. 226p. Dep. NTIS (U.S. Sales Only) $13.50.

The specific heat C_P of plutonium and neptunium was measured below room temperature. The encapsulation method was used in such a way that the calorimeter formed the encapsulation, and the canned specimens could then be handled in an inactive cryostat.

The magnitude of the self-heat, particularly of plutonium, meant that a continuous heating method had to be evolved which could deal with the inevitable high rates of rise of temperature. A cryostat and measuring system were constructed and developed such that the specific heat could still be determined with reasonable accuracy. A control system was also developed in order that an adiabatic technique could be employed. The self-heat was utilized as a constant power supply to the calorimeter. A review of the literature values of the half-lives and decay energies of the various radioisotopes present in any sample of a transuranic metal is given since the calculation of the self-heat is critically dependent on these quantities. C_P of α-plutonium followed a smooth "sigmoid" curve, except for a small "excess" between 40 and 70°K, though the magnitude of the excess (2.5 to 3%) was not sufficient to produce a maximum in C_P. C_P values were generally high, rising to a value of 7.86 cal/mole/deg at 300°K, and analysis of the data gave an electronic coefficient (γ) of 38×10^{-4} cal/mole/deg^2 and Debye theta (θ_D) values between 150 and 170°K in the temperature range 14 to 300°K. Further analysis and separation of the excess yielded a contribution to the specific heat which had the typical λ-shape of a magnetic transition, though the energy and entropy involved were extremely small. Results indicate that the suggested paramagnetic–antiferromagnetic transition at ~60°K is not an unreasonable hypothesis. Lack of affirmative evidence from neutron diffraction experiments however has necessitated a review of alternative theories and a comparison with the known antiferromagnetic α-manganese. Short-term self-irradiation experiments were carried out on α-plutonium. The energy stored by the defects produced by storage at low temperatures, and the temperature range in which this annealed out, were found to agree with theoretical estimates and the self-irradiation damage effects previously observed on the electrical resistivity. C_P of α-neptunium was found to be a smooth curve throughout the range 7.5 to 300°K, and the values of $\gamma = 34 \times 10^{-4}$ cal/mole/deg^2 and $\theta_0 = 187.5$°K resulted from analysis of the low-temperature region. No evidence of any magnetic phenomena was seen on α-neptunium. In view of the large electronic coefficients observed in plutonium and neptunium, a discussion is given on the band structure of the actinides in relation to their electronic properties. The analyses of the specific heat data are dependent in the first place on a reduction of C_P to C_V. Lack of sufficient data on the expansion coefficients (α_L) of plutonium and neptunium led to the measurement of α_L for these two metals in the temperature range 20 to 300°K. A simple push-rod dilatometer technique was used, and expansion coefficients of $\sim 45 \times 10^{-6}$ deg for α–Pu and $\sim 20 \times 10^{-6}$/deg for α–Np were found. The Grueneisen gamma values were ~2.6 for α–Pu and ~1.8 for α–Np respectively. The specific heat of PuC was investigated down to ~12.5°K. Other low-temperature properties of this metallic carbide had again suggested antiferromagnetic behavior below 100°K. No evidence in support of this was found on the specific heat results though an extremely high density of states at the Fermi surface is suggested. The standard thermodynamic functions of plutonium, neptunium, and plutonium monocarbide were calculated and are tabulated. (78 references) (DLC)

8662 (COO-3158-17) DEFECTS IN METAL CRYSTALS. Annual Progress Report, May 1, 1972–April 30, 1973. Balluffi, R. W.; Seidman, D. N. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). Jan 1973. Contract AT(11-1)-3158. 39p. Dep. NTIS $4.00.

The objective of the present research effort was a broad investigation of the basic properties of crystal defects in metals. Attention was focused on point defects (vacancies, interstitials, and solute atoms), line defects (dislocations), and planar defects (dislocation arrays, grain boundaries and surfaces). Progress is reported in the following areas: (1) Vacancy defects in quenched platinum by field ion microscopy (FIM) and electric resistivity; (2) FIM and electric-resistivity study of vacancy defects in tungsten γ irradiated with W ions or electrons; (3) FIM studies of defects in platinum irradiated with Pt ions or electrons; (4) FIM of gold and in-situ studies of gold irradiated with gold or argon ions; (5) computer simulation of contrast effects produced by defects in FIM specimens; (6) interpretation of ledge "bright spot" contrast effects in FIM images; (7) possibility of an equilibrium array of voids in a material subject to irradiation; (8) FIM studies of solute atoms in dilute platinum alloys; (9) structures of low- and high-angle grain boundaries; (10) direct measurement of the range of a focused-collision replacement sequence in gold; (11) Automatization of FIM Data Processing; and (12) The atom-probe FIM. (auth)

8663 (EURFNR-1060) AGE-HARDENING PHENOMENA IN V–Ti, V–Ti–Si, V–Zr, and V–Hf ALLOYS WTIH REFERENCE TO THE METALLOIDS N, O, B, AND C. Scholz, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Oct 1972. 44p. (KFK-1680). Dep. NTIS $4.25.

Work performed under United States–Euratom Fast Reactor Exchange Program.

An investigation was performed to determine the influence of N, O, B, and C on the precipitation- and age-hardening-behavior of the alloys V–Ti, V–3Ti–Si, V–2Zr, and V–1Hf. The study was conducted to evaluate the influence these interstitials have on the age-hardening processes and whether this influence has to be taken into account for fuel element cladding. In addition, research was conducted on new applications for age-hardened vanadium alloys beyond the field of nuclear application. The alloys V–Ti–O and V–Hf–C showed an increase in hardness after temperature treatments. A high carbon content in the alloy V–Ti–O prevents age-hardening. Age hardening was increased by additions of boron and silicon. The age-hardening processes can be used for a possible improvement of the creep strength to temperatures up to 750°C, as above this temperature over-aging occurs after a short time. In order to avoid a too-high resistance to deformation during the extrusion of V–Ti–O alloys the extrusion temperature has to be higher than 800°C. New field of application for vanadium-base alloys beyond nuclear engineering could not be pointed out in time. (auth)

8664 (LFEN-144-a) ANALYSIS OF BINARY ZIRCONIUM–NIOBIUM ALLOYS BY X-RAY FLUORESCENCE SPECTROSCOPY. Carvalho, M. H. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 22p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $3.25.

An x-ray fluorescence method of analyzing Zr–Nb binary alloys with approximately 2.5% Nb is described. A solution technique was used. The niobium content was determined by comparing the $I_{NbK_\alpha}/I_{background}$ ratio measured in a solution of the alloy with the same value in a calibration curve, $I_{NbK_\alpha}/I_{background}$ versus % Nb, previously established with the aid of synthetic standard solutions. This is a time-saving method of analysis once the calibration curve is established. The relative standard deviation is 0.02% Nb in a synthetic alloy of 2.5% Nb. (tr-auth)

8665 (ORNL-TM-3856) ELASTIC–PLASTIC–CREEP TESTS OF TYPE 304 STAINLESS STEEL (HEAT 8043813) BEAMS. Corum, J. M.; Richardson, M. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 53p. AT $4.75.

The room-temperature elastic–plastic beam test and the two companion elevated-temperature beam tests reported here were performed to provide structural analysts with elastic–plastic and creep-test data obtained from simple structures made of a well characterized material. The tests were carried out as a part of ORNL's program to develop high-temperature structural design methods for liquid-metal fast breeder reactor (LMFBR) system components. The simply supported center-loaded beams were made of an RDT (nuclear grade) heat of type 304 stainless steel. The two elevated-temperature tests were at 1200°F, and the loading histories for the two beams were chosen so that together the tests provide information on some of the essential aspects of elastic-plastic and creep behavior as well as information regarding the effects of prior creep on subsequent elastic-plastic behavior and the effects of prior elastic-plastic behavior on subsequent creep behavior. In addition to the beam test results, the material property data that the analyst will need for making analytical predictions for comparison with the test results are given. (auth)

8666 (ORNL-TM-4105, pp 4.1-4.37) MECHANICAL PROPERTIES FOR STRUCTURAL MATERIALS. May 1973.

In fuels and materials development program quarterly progress report.

All of the first-purity (A-1) creep tests designated for 50,000 h in the type 304 stainless steel data list are underway. Construction of nine more creep stands for precision testing was initiated, all of these units are to be used for the baseline testing type 304 stainless steel. Creep characterization of the reference heat by-product form is in progress. This series to date involves $\frac{3}{8}$-, $\frac{1}{2}$-, $\frac{3}{4}$-, and 2-in. plates, 4-in.-dia sched.-160 and 8-in.-dia sched.-80 pipe, and $1\frac{3}{4}$-in. bar. Creep tests on the heat-to-heat variation study of type 304 stainless steel are proceeding, results of tests at 593°C indicate a 1.6% total strain variation in the behavior of seven heats for times of about 11,000 h at a stress of 17,000 psi. In exploratory tests to evaluate creep-hardening rules, the results from low stress tests were not conclusive, but at high stress the strain-hardening rule seems to be realistic. Although cyclic work is not failure oriented, the surfaces of specimens after discontinuing the tests were examined. Cracks were observed in type 304 stainless steel at strain ranges in excess of 1%, especially at strain rates of 0.005/min and lower. Cracking has been observed often for cycling conditions in the vicinity of the code allowable. (auth)

8667 (RD/B/M-2419) PRECIPITATION IN 20% Cr–25% Ni–Nb STABILIZED STEELS. A Literature Survey. Knowles, G. (Central Electricity Generating Board, Berkeley (England). Berke-

ley Nuclear Labs.). Feb 1973. 38p. Dep. NTIS (U.S. Sales Only) $4.00.

References in the literature for second phase precipitation in 20% Cr–25% Ni–Nb stabilized steel are surveyed. In order to delineate the areas where further work is required, the structure, solubility, nucleation, and morphology of each precipitate is dealt with in turn. The effects of irradiation and trace element impurities upon the precipitation processes are also briefly considered. (9 figures, 60 references) (auth)

8668 (RD/B/N-1996) HIGH-TEMPERATURE LOW-CYCLE FATIGUE EFFECT OF NOTCHES. Cook, T. R. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Feb 1973. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

Results of tests on notched, directly stressed, fatigue specimens are reported and are compared with plain specimen tests made under similar conditions. The test material was 20% Cr–25% Ni stainless steel, and the data were obtained at 700°C. The results indicated that the Neuber formula yielded very pessimistic predictions when using strain as the crack initiation criterion. The predicted endurances were modified using the results of an evaluation of the effect of strain rate. These predictions were more realistic, but were generally still pessimistic. It is therefore concluded that the notch effect is not as damaging as the predictions indicated for this case. (auth)

8669 (REG/G-1-36(2-73)) NONMETALLIC THERMAL INSULATION FOR AUSTENITIC STAINLESS STEEL. (Directorate of Regulatory Standards (AEC), Washington, D.C.). 23 Feb 1973. 2p. DRS, Washington, DC Free.

This regulatory guide applies to light-water reactors and describes an acceptable method for implementing criteria with regard to selection and use of thermal insulation to minimize any contamination that could promote stress-corrosion cracking in the stainless steel portions of the coolant pressure boundary and other systems important to safety. (LMT)

8670 CHOOSING THE RIGHT MATERIALS. As an Example the Selection of a Cladding Material for a Nuclear Fuel Element. Gittus, J. H. (United Kingdom Atomic Energy Authority, Springfields, Eng.). Qual. Eng.; 37: No. 2, 44-47(Feb 1973).

A short section is included on the selection of nuclear fuel cladding materials, with particular application to stainless steel, and the use of computer analysis of fuel pins. (UK)

8671 CREEP ANALYSIS OF TRANSVERSELY ISOTROPIC BODIES SUBJECTED TO TIME-DEPENDENT LOADING. Donea, J.; Giuliani, S. (EURATOM, Ispra, Italy). Nucl. Eng. Des.; 24: No. 3, 410-419(1973).

An analysis and a numerical computer program are developed for the purpose of solving creep problems for transversely isotropic bodies subjected to time-dependent loading. Plane stress, plane strain, generalized plane strain and axisymmetric situations can be analyzed. The finite element method is used as the basic numerical technique and the nonlinear effects arising from creep are included by the use of an incremental procedure. Fourth-order Runge–Kutta formulas are applied to advance the solution. The method is independent of the type of creep law used. Numerical applications are presented to demonstrate the variety of problems which can be analyzed by the program. (auth)

8672 KINETICS OF THE DEGASSING OF OXYGEN-CONTAINING NIOBIUM IN FLOWING ACETYLENE TO FORM CARBON MONOXIDE. Hoerz, G.; Lindenmaier, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 64: No. 3, 161-169(1973). (In German).

Thin niobium wires (0.5 mm dia) with concentration of dissolved oxygen between 0.2 and 0.6 at.% were degassed at temperatures between 1390 and 2000°C in flowing acetylene at partial pressures between 3.3×10^{-6} and 1.3×10^{-5} torr to form carbon monoxide. The degassing reaction was followed by continuously measuring both the electrical resistivity of the specimens and the carbon monoxide partial pressure in the reaction chamber. At high temperatures, T, low acetylene partial pressures, pC_2H_2, and at short reaction times, a reaction range I/A exists where the rate of the degassing reaction obeys the relation $v_O = 18.5 \times p(C_2H_2)$, with v_O in mg O/cm^2 × sec, pC_2H_2 in torr, and T in °K; v_O is determined by the rate of acetylene transport to the specimen surface with subsequent physical adsorption. In the reaction range I/A, practically no carbon is dissolved in niobium. At lower temperatures and higher acetylene partial pressures (reaction range I/B) the conditions are more complicated and can only be discussed qualitatively. The same is true for reaction range II which occurs at longer reaction times. It is shown that, in the presence of acetylene, at least in the reaction range I/A, the reaction of oxygen degassing of niobium by the evaporation of the oxide NbO plays no role in the concentration, temperature, and pressure range investigated. (GF)

8673 MATERIALS OF CONSTRUCTION FOR PUMPS. II. Metals and alloys. Nicholas, J. L. Pumps; No. 74, 520-525 (Nov 1972).

Compositions, mechanical properties, and corrosion-resistances of various metals and alloys are presented and discussed as a guide to pump-material selection. The materials considered include: Pb; Ni; Ti; Ta; Zr; and cast iron; plain C-, alloy-, and stainless steels; phosphor-, Al-, Sn-, and Ni–Al bronzes; and Monel, Inconel, Incoloy, Langalloy, Hastelloy; and Ni and Pb alloys. (Metals Abstr.)

8674 NEW APPROACH TO THE FINITE-ELEMENT FORMULATION AND SOLUTION OF A CLASS OF PROBLEMS IN COUPLED THERMOELASTOVISCOPLASTICITY OF CRYSTALLINE SOLIDS. Oden, J. T.; Bhandari, D. R.; Yagawa, G.; Chung, T. J. (Univ. of Alabama, Huntsville). Nucl. Eng. Des.; 24: No. 3, 420-430(1973).

The application of the general thermoviscoelastic-plastic theory to the analysis of the coupled thermomechanical response of a class of crystalline solids is considered. After a brief review of the essential features of the theory, the manner in which finite-element models of the generalized plastic behavior can be formulated is discussed. Available experimental data are used to solve a representative example problem in transient, nonlinear, coupled thermoviscoelastoplasticity of a three-dimensional solid of aluminum. (auth)

8675 BSCC HIGH-TEMPERATURE DATA. British Long-term Creep-rupture and Elevated-temperature Tensile Data on Steels for High-temperature Service. London; Iron and Steel Institute (1973). 735p.

The data are presented in sections: carbon and carbon–manganese steels (semi-killed carbon and carbon–manganese steels, silicon-killed carbon and carbon–manganese steels, silicon-killed aluminum-treated carbon and carbon–manganese steels); alloy steels (½ Cr–½ Mo–¼ V steels, 1 Cr–½ Mo steels, 2¼ Cr–1 Mo steels, 9 Cr–1 Mo steels, 12 Cr–Mo–V steels); austenitic steels (18 Cr–8 Ni steels (type 304), 18 Cr–12 Ni–Mo steels (type 316), 18 Cr–10 Ni–Ti steels (type 321), 18 Cr–12 Ni–Nb steels (type 347)); steels to British Standards (semi-killed niobium-treated carbon and carbon–manganese steels, silicon-killed niobium treated carbon and carbon–manganese steels, molybdenum–boron steels including steels complying with BS 1501-261, manganese–chromium–molybdenum–vanadium steels and nickel–chromium–molybdenum–vanadium steels, including steels complying with BS 1501-271 and BS 1501-281, nickel–chromium–molybdenum–vanadium steels including steels complying with BS 1501-282)). Data on individual steels are presented: (a) in tabulated form (Table 1: details of test materials; Table 2: tensile test results; Table 3: stress rupture test results); and (b) in graphical form (tensile test results: high-temperature proof stress vs room-temperature tensile strength (or proof stress) plots; and stress-rupture test results: log stress vs log time plots). (UK)

8676 STEAM REFORMING CATALYSTS. Nicklin, T.; Whittaker, R. J.; Farrington, F. (to Gas Council). British Patent 1,307,992. 21 Feb 1973. Filed date 19 Jun 1969. 5p.

Reference is made to catalysts suitable for use in the reforming of hydrocarbons with steam. The catalyst described comprises a carrier on the surface of which is a mixture of NiO and/or Ni, together with one or more oxides of U, the ratio of U to Ni being from 0.62 to 1 to 0.74 to 1. The catalyst carrier comprises α–Al_2O_3. The catalyst may also contain K_2O or Li_2O or compounds decomposable thereto on heating; also BaO, $Ba(OH)_2$, $BaCO_3$, or Ba uranate. Methods of preparation are described, together with use in the reforming of hydrocarbons with steam. (UK)

8677 HIGH-TEMPERATURE MICROSCOPY IN THE STUDY OF SOLIDIFICATION PROCESSES IN IRON–CARBON-X ALLOYS (X = CHROMIUM OR VANADIUM). II. Results for Iron-carbon–x Alloys Containing Eutectic. Siepmann, H.; Hoener, K. E.; Schneider, W. D. Giessereiforschung; 23: No. 4, 151-158(1971). (In German).

An account is given of crystallization from the melt in Fe–C and Fe–C–X alloys, where X is Cr or V. The effects of composition, cooling rate, and initial temperature are described. Both stable and metastable systems were investigated. The structures observed and the mechanism of their formation are discussed. (Metals Abstr.)

8678 COMPONENTS OF THE YIELD STRENGTH OF TANTALUM WITH INTERSTITIAL DISSOLVED OXYGEN AND NITROGEN. Puhr Westerheide, J.; Elssner, G. (Max-Planck-Institut fuer Metallforschung, Stuttgart). (1972). 4p. (In German).

From general meeting of the Deutsche Gesellschaft fuer Metallkunde; Stuttgart, Germany (23 May 1972).

Mechanical properties of bcc metals are considerably changed by the intercalation of gases such as oxygen and nitrogen at interstitial lattice positions. The lower yield point is an important characteristic parameter describing these changes. Recent investigations have shown that the lower yield strength is made up of several components. Dependence on the deformation temperature and the rate of deformation, as well as on the concentration of dissolved gases, is different for every single component. Hence deformation tests have been carried out on tantalum wires having a bamboo structure in order to determine the tensile strength and the characteristics of the various components. Measurements have been made within the temperature range of –60 to +90°C, at a rate of deformation between 2×10^{-5} and 1.6×10^{-3} sec^{-1} on samples which had been doped with a maximum of 1 at.% oxygen and/or nitrogen. The lower yield point increases with a rising concentration of dissolved oxygen and nitrogen, with increasing rate of deformation and with decreasing deformation temperature, and is the sum of the components described. An attempt is made to develop a model describing the movement of the dislocations in the tantalum lattice. (GF)

8679 MATERIALS FOR HEAVY COMPONENTS IN [NUCLEAR] REACTORS. Listhuber, F.; Wallner, F.; Oberhauser, F. M. Berg-Huettenmaenn. Monatsh.; 117: No. 5, 149-158(May 1972). (In German).

The development of special steel grades for nuclear energy plant applications is discussed. The heavy components for which these steels are used and the requirements of nuclear engineering materials are described. American and European steel grades are listed and particular attention is paid to the Al-containing Si–Mn structural, Mn–Ni–Mo–V, Ni–Mo–Cr, and high-alloy steels, e.g., Type X3 CrNi 134. The alloy steel mentioned is 22 NiMoCr 37, which is used for pressure vessels, and modified in the European grades by having a lower C content and being refined as fine-grained steel. The X3 CrNi 13 4 grade is expected to be used in the He-cooled reactors of the future. (Metals Abstr.)

8680 CLOSE ORDERING IN MAGNESIUM–CADMIUM ALLOYS. Germanov, E. P.; Shivrin, O. N. Uch. Zap. Petrozavodsk. Gos. Univ.; 16: No. 6, 233-237(1971). (In Russian).

Measurements were made of x-ray diffuse scattering, electrical resistance, and lattice constants in Mg–Cd and Cd–Mg alloys containing 5, 10, 15, and 20 at.% of the second component. Specimens were homogenized and then the Cd- and Mg-based alloys were quenched at 250 and 300°C, respectively. A study was made of the effect of annealing at temperatures in the range 50 to 200°C. For the quenched specimens, there was a clear wide intensity max of diffuse scattering in the region of the first superstructure lines. The value of this max increased with increasing additions of the second component and was accompanied by a shift toward lower angles. Subsequent annealing had little effect on the diffuse scattering. It was calculated that the predominance of atoms of the second type in the first coordination sphere was >10% of their number for a random distribution. The absence of any relation between the degree of order and annealing after quenching shows that an equilibrium degree of order is reached very rapidly. The energy of ordering is 0.03 eV/atom. (Metals Abstr.)

8681 COMPOSITION AND STABILITY OF $CaCu_5$-TYPE COMPOUNDS OF YTTRIUM WITH IRON AND COBALT. Buschow, K. H. J. (Philips Research Labs., Eindhoven, Netherlands). J. Less-Common Metals; 31: No. 3, 359-364(Jun 1973).

The dependence of composition on iron concentration was studied for pseudobinary $CaCu_5$-type compounds of Y with Fe and Co. Increasing Fe concentration leads to an increasing deviation from the stoichiometric composition. The temperature range in which these pseudobinary compounds are stable increases with Fe concentration. At low temperatures, the compound YCo_5 is shown to undergo a eutectoid decomposition. Iron impurities increase the decomposition temperature. The application of the pseudobinary $CaCu_5$-type compounds as starting materials for permanent magnets is briefly discussed. (auth)

8682 RELATION OF THE TEMPERATURE OF THE BRITTLE–VISCOUS TRANSITION WITH STRUCTURAL CHARACTERISTICS OF SOME LOW ALLOYED CHROMIUM ALLOYS. Karsanov, G. V.; Khazanova, T. P.; Zolotorevskii, V. S.; Indenbaum, S. V.; Teleshov, V. V.; Novikov, A. I. Metallofizika; No. 43, 112-115(1972). (In Russian).

The effect of individual structural characteristics and their effect, in the aggregate, of low-alloyed Cr alloys on their inclination toward brittle disintegration were studied by means of the statistical methods of correlative and regressive analysis. The systems Cr–Ti–N, Cr–Ti–Mo–N, Cr–Y–V–B and Cr–Ti–V–B, with the total quantity of alloying elements <6%, the greatest effect on the temperature of brittle–viscous transition (T_x) was the quantity and particle dimensions of the excess phase. (tr-auth)

8683 TWIN-JET THINNING TECHNIQUES FOR TRANSMISSION ELECTRON MICROSCOPY OBSERVATION OF TANTALUM AND NIOBIUM. Sikka, V. K.; Michel, D. J.; Moteff, J. (Univ. of Cincinnati). Contract AT(11-1)-2093. J. Less-Common Metals; 31: No. 2, 311-313(May 1973).

The successful thinning of tantalum and niobium was achieved using a conventional twin-jet electropolishing unit, a one-step procedure, and at low applied potentials. Commercial-purity Ta foils of thicknesses ranging from 2 to 10 mil were thinned in a twin-jet, electropolishing unit using an electrolyte of 600 ml CH_3OH, 30 ml H_2SO_4, and 7.5 ml HF held at room temperature. The substructure observed for the case of a 5-mil as-received Ta foil shows typical subgrain boundary mobile dislocations and small loops within the subgrains. For Nb, polishing was very sensitive in relation to electrolyte temperature. The electrolyte used was 558 ml CH_3OH, 30 ml H_2SO_4, and 12 ml HF. The electropolished specimens were washed with ethanol, dried, and observed with an electron microscope. (JCW)

8684 THERMAL CONDUCTIVITY AND LORENZ FUNCTION OF NEODYMIUM AT LOW TEMPERATURES. Tee, K. T. (Dalhousie Univ., Halifax, N.S.); Rao, K. V.; Meaden, G. T. J. Less-Common Metals; 31: No. 2, 181-185(May 1973).

Measurements of the thermal conductivity of antiferromagnetic and paramagnetic neodymium are reported for the temperature range 2 to 45°K. Anomalous behavior, whose prominence increases with annealing, is associated with a magnetic transition near 6°K. Annealing raises the electrical conductivity but for temperatures exceeding 5°K lowers the thermal conductivity. At the same time the Lorenz function is reduced significantly at all temperatures. (auth)

8685 ENHANCED STRAIN AGING OF NIOBIUM BY CYCLIC DEFORMATION. Shah, D.; Altstetter, C. (Univ. of Illinois, Urbana). J. Less-Common Metals; 31: No. 2, 187-195(May 1973).

Niobium specimens containing interstitial solute were prepared in the form of 0.037 in. diam. wires which were cyclically loaded in tension at room temperature under load control. The return of discontinuous yielding and the increase in flow stress have been compared with conventionally strain-aged specimens. It was found that strain-aging was accelerated by cyclic deformation and the yield drop and flow stress increase were greater than in specimens aged at the same temperature, but without cycling. It is suggested that the effect is due to the interaction of solute atoms with the moving dislocations rather than to diffusion of solute to stationary dislocations, thereby pinning them. (auth)

8686 SIGMA PHASE IN MOLYBDENUM–RHENIUM: MICROSTRUCTURE AND SUPERCONDUCTING HYSTERESIS. Witcomb, M. J.; Dew Hughes, D. (Univ. of Lancaster, Eng.). J. Less-Common Metals; 31: No. 2, 197-209(May 1973).

A systematic study of σ-phase precipitation in a Mo–34 at.% Re alloy shows nucleation to be difficult, but greatly assisted by prior deformation of the matrix. Main nucleation sites have been determined by electron microscopy. Magnetic hysteresis in the superconducting state has been studied. Flux pinning by interaction of flux vortices with σ-phase precipitates is compared with that due to different dislocation arrangements. (auth)

8687 STRUCTURE, MORPHOLOGY, AND ORIENTATION RELATIONSHIP OF V_3N IN α-VANADIUM. Potter, D. I. (Union Coll., Schenectady, NY). J. Less-Common Metals; 31: No. 2, 299-309(May 1973).

The precipitation of the V_3N phase in the α phase of the V–N system was investigated using transmission electron microscopy and diffraction. This phase is shown to be cph in respect to metal atoms and the nitrogen atoms are ordered in an interpenetrating hexagonal structure. Precipitation proceeds by nucleation and growth of V_3N particles in the α-phase. At a size of about 5000 Å the growing particle causes plastic deformation of the matrix. Twins with $K_1 = \{10.1\}$ are present throughout the growth process and these are shown to result from restraints imposed by the matrix. The plate-like morphology of the V_3N has a habit plane near $\{112\}_{bcc}$. The orientation relationship is only approximately that of Burgers and is best described as $(10.1)_{cph}$ 11 $(110)_{bcc}$, where $(10.1)_{cph}$ is the particular $\{10.1\}_{cph}$ plane which is also the twin plane in the particle. In this plane the close-packed directions are rotated by 2.4 ± 0.2°. Energetic considerations relating to the precipitate shape and the orientation relationship are discussed. (auth)

8688 STUDY OF THE Nb–Al–Si SYSTEM. I. Partial Isothermal Sections at 1500 and 1300°C and Behavior of the Nb(Si,

$Al)_2$ Phase. Allibert, C.; Wicker, A.; Driole, J.; Bonnier, E. (Univ., Grenoble, France). J. Less-Common Metals; 31: No. 2, 221-228(May 1973). (In French).

The part of the system of Nb–Al–Si that is bounded by Al, Si, $NbSi_2$, and $NbAl_3$ was studied. In this region, two isothermal sections at 1500 and 1300°C were established by the electromagnetic phase-separation method. The study of the behavior of the Nb(Si, $Al)_2$ phase indicates that peritectic decomposition occurs during cooling. (tr-auth)

8689 STUDY OF THE Nb–Al–Si SYSTEM. II. Analysis of Ternary Nb–Al–Si Alloys by Atomic Absorption Spectrophotometry. Molins, R.; Garden, J.; Bozon, H.; Driole, J. (Univ., Grenoble, France). J. Less-Common Metals; 31: No. 2, 229-237 (May 1973). (In French).

A method is presented for the analysis of Nb–Al–Si alloys by atomic absorption spectrometry. The following factors were tested for each element: the influence of the acid solvent, the influence of the two other components, and the flame conditions. The method and some results are given. (tr-auth)

8690 STUDY OF THE β'-PdIn PHASE. Fort, D.; Smallman, R. E.; Harris, I. R. (Univ. of Birmingham, Eng.). J. Less-Common Metals; 31: No. 2, 263-279(May 1973).

A study of the magnetic susceptibility of alloys across the homogeneity range of the β'-phase PdIn, has shown differing behavior at either side of the stoichiometric (50% In) composition upon heating both "annealed" and "as-quenched" alloys. Susceptibility, density, hardness, and lattice spacing results are discussed in relation to the probable constitutional and thermal defects present. (auth)

8691 REACTION OF TUNGSTEN WITH SULFUR VAPOR. Dutrizac, J. E. (Dept. of Energy, Mines, and Resources, Ottawa). J. Less-Common Metals; 31: No. 2, 281-297(May 1973).

A thermogravimetric method has been used to investigate the kinetics of the reaction of both annealed and unannealed tungsten coupons with pure sulfur vapor at temperatures between 295 and 550°C. The rates of sulfurization of both forms of metal were rapid and increased systematically with temperature to a rate maximum at 460 to 475°C; thereafter the rates decreased. At temperatures below the rate maximum, the apparent activation energies were in the range 31 to 34 kcal/mole. For the annealed metal, the kinetics were essentially linear. The kinetics of sulfurization of the unannealed metal were linear above the rate maximum but, below this transition temperature, the reaction rate increased with time. For both forms of metal, the initial sulfurization rates increased in a complex manner with increasing sulfur pressure for temperatures below the rate maximum. Above this transition temperature, the rates increased directly with the partial pressure of S_2. Tungsten disulfide was the only reaction product detected under all experimental conditions. (auth)

8692 CRYSTAL STRUCTURE OF $SmCo_5$. Khan, Y.; Feldmann, D. (Ruhr Univ., Bochum, Ger.). J. Less-Common Metals; 31: No. 2, 211-220(May 1973).

An alloy having the composition $SmCo_5$ has been considered to be a single-phase compound with the $CaZn_5$-type structure. It is shown by x-ray analysis and other methods that this material is actually always obtained as a composite of two phases, one having the $CaZn_5$-structure and the other being a variant of that structure with doubled lattice constants. (auth)

8693 ANALYTICAL DESCRIPTION OF Cs–W–O ADSORPTION PHENOMENOLOGY. Rasor, N. S. pp 181-186 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038–.

An approach is outlined that allows immediate identification of impurity or additive effects on the familiar T/T(R) plots, their tentative association with the basic process involved, and their quantitative characterization. The approach is illustrated by interpretation of recently published data on work function changes of tungsten in pure oxygen and in cesium–oxygen mixtures. The results confirm the earlier elementary co-adsorption model based on less extensive data, and identify molecular dissociation and bulk oxidation as major processes affecting the work function of the Cs–W–O surface. (auth)

8694 WORK FUNCTIONS OF SOME EMITTING AND COLLECTING REFRACTORY METAL SINGLE CRYSTALS. Schins, H. E. J.; Ooms, M. C.; van Wijk, R. W. M. (EURATOM, Ispra, Italy). pp 199-202 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038–.

A modification of the Shelton method for the determination of work functions is described. Preliminary results on refractory metal single crystals are given. The (hot) emitter work functions of W(110, 100, 111, 210), Mo(110), Ta(110, 100) correspond to literature values, but a different value (4.40 Ev) was measured for Nb(100). The (cold) collector work functions in a 1-nanotorr vacuum are random, up to 0.5 eV higher than the bare work function. The saturated, temperature-dependent oxygen coverings of Engelmaier and Stickney and other workers were confirmed. (auth)

8695 HIGH-FIELD MAGNETIZATION OF LIGHT RARE-EARTH METALS. McEwen, K. A. (H. C. Ørsted Institute, University of Copenhagen, Copenhagen, Denmark); Cock, G. J.; Roeland, L. W.; Mackintosh, A. R. Phys. Rev. Lett. 30: No. 7, 287-290 (12 Feb 1973).

The magnetization of single crystals of Eu, Sm, Nd, Pr, and Pr–Nd alloys has been measured in fields up to 37 T (370 kG). The results give new information on the magnetic properties of these metals. Of particular interest is a first-order transition from a nonmagnetic to a metamagnetic phase in double-hexagon close-packed Pr, due to the crossing of crystal-field levels, when a field of about 32 T is applied in the hard direction at low temperatures. (auth)

8696 THERMAL-RESISTIVITY ANISOTROPY OF ZINC AND CADMIUM. Pecheur, P.; Toussaint, G. (Institut National Polytechnique de Nancy, Laboratoire Associé au Centre National de la Recherche scientifique n° 155, Parc de Saurupt, 54000 Nancy, France). Phys. Rev. B 7: No. 4, 1223-1226 (15 Feb 1973).

The Mannari–Ziman–Baym theory has been used to calculate the phonon-limited thermal resistivity of hexagonal metals in the two symmetry directions. This calculation introduces an inelastic contribution peculiar to anisotropic metals. A numerical computation using empirical form factors and experimental phonon spectra shows that this term could explain the low-temperature behavior of zinc. (auth)

8697 NUCLEAR MAGNETIC RESONANCE, MAGNETIC SUSCEPTIBILITY, AND LATTICE CONSTANTS OF SOLID AND LIQUID $AUGA_2$, $AU_{0.95}PD_{0.05}GA_2$, AND $AUIN_2$. Warren, W. W. Jr.; Shaw, R. W. Jr.; A. Menth; DiSalvo, F. J. ; Storm, A. R.; (and others) (Bell Laboratories, Murray Hill, New Jersey 07974). Phys. Rev. B 7: No. 4, 1247-1263 (15 Feb 1973).

We report measurements of the magnetic susceptibility, Knight shift, and nuclear spin–lattice relaxation rates in the pure compounds $AuGa_2$ and $AuIn_2$ and an alloy of nominal composition $Au_{0.95}Pd_{0.05}Ga_2$. Measurements were made in both the solid and liquid states over a temperature range from 4.2 to 1100 K. Lattice constants were measured from 4.2 to 300 K for $AuAl_2$, $AuIn_2$, and $Au_{0.95}Pd_{0.05}Ga_2$ and to 715 K for $AuGa_2$. The susceptibilities, Ga Knight shifts, and magnetic relaxation rates of $AuGa_2$ and $Au_{0.95}Pd_{0.05}Ga_2$ exhibit complex temperature dependences which, with the exception of the Knight shift, continue to the vicinity of the melting point. The Knight shifts become constant above 400 K. At low temperatures the Knight shifts and relaxation rates in $Au_{0.95}Pd_{0.05}Ga_2$ are strongly enhanced relative to $AuGa_2$, but the alloy data converge to those of the pure compound as the temperature increases. The changes in magnetic properties at the melting point are small compared with their temperature-dependent variations in the solid state. Lattice-constant data for $AuGa_2$ and $AuIn_2$ suggest anomalous thermal-expansion behavior for these compounds below 100 K. The magnetic properties of $AuIn_2$ exhibit comparatively weak temperature dependence over the entire temperature range covered. We propose a phenomenological explanation for these results in terms of temperature-dependent modification of the electronic structure toward an essentially free-electron situation in the solid near the melting point. (auth)

8698 THEORY OF THE EFFECT OF IMPURITIES ON THE α–γ TRANSITION IN CERIUM. Alascio, B.; López, Arturo (Centro Atómico Bariloche, Comisión Nacional de Energía Atómica, Instituto de Física "Dr. José A. Balseiro," Universidad Nacional de Cuyo, Bariloche, Argentina); Olmedo, C. F. E. Phys. Rev. B 7: No. 4, 1274-1279 (15 Feb 1973).

The Pamirez–Falicov model for the α–γ transition in Ce has been extended to describe Ce–rare-earth dilute alloys. Changes in the transition temperatures and pressures predicted by the model, are in good agreement with existing experiments. The most important effect of the impurities is to lower the transition temperature, the effect being more marked for divalent impurities. The assumption that in this way an ordering (Néel) temperature can be reached leads to the prediction of a phase diagram for these alloys similar to that found for Cr-doped V_2O_3. (auth)

8699 LATTICE DYNAMICAL STUDY OF INDIUM. Sharan, B. (Department of Science Education, National Council of Educational Research and Training, New Delhi-16, India); Kumar, Ashok. Phys. Rev. B 7: No. 4, 1362-1367 (15 Feb 1973).

The lattice dynamics of the body-centered tetragonal crystal has been investigated. The interatomic forces considered include, in addition to the central forces and angular forces of the type employed by Clark,

Gazis, and Wallis, those forces arising from certain energies owing to the compressibility of the conduction electrons and their interaction with ions. The approach has been utilized to stydy the metal indium, and results are presented for the dispersion curves and the Debye temperature. (auth)

8700 THERMODYNAMICS OF α-SOLID SOLUTIONS OF SILVER WITH INDIUM AND TIN. Alcock, C. B.; Jacob, K. T.; Palamutcu, T. (Univ. of Toronto). Acta Met.; 21: No. 7, 1003-1009(Jul 1973).

A solid oxide galvanic cell and a gas–solid (CO/CO_2–Ag-oxide) equilibration techniques were used to measure the activities of the solutes in the α-solid solutions of silver with indium and tin. The results are consistent with the information now available for the corresponding liquid alloys, the phase diagram and the heats of mixing of the solid alloys. When the results of this study are taken together with published data for the α-solid solutions in Ag + Cd system, it is found that the variation of the excess partial free energy of the solute with mole fraction can be correlated to the electron/atom ratio. The significant thermodynamic parameter that explains the Hume–Rothery findings in these alloys appears to be the rate of change of the excess partial free energy with composition near the phase boundary, and this in turn reflects the value of the solute–solute interaction energy. (auth)

8701 INTERSTITIAL EFFECTS ON THE TENSILE BEHAVIOR OF NIOBIUM BETWEEN 20 AND 1000°C. Mazot, P. (CNRS, Poitiers, France). Acta Met.; 21: No. 7, 943-950(Jul 1973). (In French).

Large hardening and instability occurring in niobium at certain temperatures were observed by analysis of tensile tests performed on niobium samples in the 20 to 1000°C temperature range. On the basis of these data, the deformation stress, $\sigma(\epsilon,\dot{\epsilon},T)$ is decomposed into a sum of three factors: $\sigma(\epsilon,\dot{\epsilon},T) = \sigma_0(T) + \Delta\sigma_\rho(\epsilon,\dot{\epsilon},T) + \Delta\sigma_i(\epsilon,\dot{\epsilon},T)$, where σ_0 is the plastic flow threshold, and $\Delta\sigma_\rho$ a "normal" strengthening term. The analysis of the third term, $\Delta\sigma_i$, which was related to hardening effects due to interstitials by some authors, is reported. From $\Delta\sigma_i$ variation with temperature, evidence is shown that several successive hardening peaks appear, with a characteristic maximum amplitude and a specific temperature for each of them. The relation between one of these peaks and oxygen is evidenced by some tests performed on oxygen-doped niobium samples. The tensile rate effect on the peak characteristics is established through other experiments. The mechanism for the apparition of these hardening effects is deduced from these results. The hardening peak amplitude variation and the temperature peak shift with tensile rate are explained in terms of a distribution law of dislocation rates and the basal relation of plastic flow: $\dot{\epsilon} = \phi \cdot \rho_m \cdot \nabla \cdot b$. In order to take into account the discrepancy between Cottrell law $\dot{\epsilon} = 19^9 D$ and experimental results, a variation law for mobile dislocation density is proposed: $\rho_m = h\dot{\epsilon}^m$, where m is approximately 0.3 to 0.4. (auth)

8702 ACTIVITY OF INDIUM IN α-SOLID SOLUTIONS OF Cu + In, Au + In, AND Cu + Au + In ALLOYS. Jacob, K. T.; Alcock, C. B. (Univ. of Toronto). Acta Met.; 21: No. 7, 1011-1016(Jul 1973).

Thin foils of Cu, Au, and Cu + Au alloys embedded in indium sesquioxide were equilibrated with controlled streams of $CO-CO_2$ mixtures. The equilibrium concentrations of indium in the foils were determined by neutron activation analysis. The corresponding chemical potentials of indium were calculated from the standard free energies of formation of carbon monoxide, carbon dioxide, and indium oxide. It was found that the size difference between the solute and the solvent does not make significant contributions to the solute–solute interaction energy in the α-phase. The chemical potential of indium at 1 at. % concentration is 8.6 kcal more negative in gold than in copper at 900°K. The variation of this chemical potential with alloy composition in Cu + Au system was in good agreement with Alcock and Richardson's quasi-chemical equation. The agreement is strengthened by the accurate knowledge of the coordination number in these substitutional solid solutions from x-ray diffraction studies. (auth)

8703 TRACE OF YTTRIUM IN ACSR ALUMINUM BOOSTS TRANSMISSION LINE EFFICIENCY 50%. Matsuda, Y.; Yokota, M.; Okumura, T. Wire J.; 5: No. 2, 53-60(Feb 1972).

A research program on the recrystallization reaction in Al–Zr alloys led to the development of an alloy with Y additions for overhead electrical transmission lines. The electrical conductivity is ~2% higher than conventional alloys, the creep resistance and fatigue strength are good, and the heat resistance is very high. Corrosion resistance appears to be identical to that of conventional alloy and EC-grade Al. (Metals Abstr.)

8704 THERMAL CONDUCTIVITY AND LORENTZ NUMBER OF TUNGSTEN–RHENIUM ALLOYS IN SOLID-SOLUTION REGION (0 TO 27% Re) AT TEMPERATURES OF 1200 TO 3000°K. Vertogradskii, V. A.; Chekhovskoi, V. Ya. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 893-896 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 993-996(1972).

Information is given on the thermal conductivity of four alloys measured with a precision of 3 to 5%. It is found that the Lorentz number of the alloys depends linearly on the product of the atomic concentrations of the components. (auth)

8705 SOME RECENT DEVELOPMENTS IN HEAT-RESISTING MATERIALS. Stephenson, N. (International Nickel Ltd., London); Anant Narayan, S. N. pp 93-124 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

Materials are described which are mostly alloys of the nickel–chromium, nickel–chromium–cobalt or nickel–chromium–iron types which contain additions of titanium and/or aluminum and frequently, also, additions of refractory elements such as molybdenum, tungsten, niobium, and tantalum. New developments in these materials are considered by fields of application. Gas turbines are described first since it is in this field that most of the developments in heat resisting materials have taken place. Developments in design of thermal power generating plants have been towards increasing size and increasing steam temperature and pressure. High-temperature materials are being specified in power plants for certain applications. Applications of high-temperature materials in the industrial processing and other uses are also discussed. (auth)

8706 X-RAY-DIFFRACTION STUDY OF DEFORMED Mo–Re ALLOYS. Gupta, R. K.; Anantharaman, T. R. (Banaras Hindu Univ., India). pp 407-416 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyderabad, India (21 Feb 1972). See CONF-720223-.

A detailed x-ray line-broadening study of deformed Mo–Re alloys containing from 2.46 to 18.27 at. % Re was made using Fourier as well as integral breadth methods. There is no evidence of faulting on deformation in these alloys. The dislocation densities are found to be of the order of 10^{11} cm/cm^3. The increase in dislocation density with Re content has a marked similarity to the increase in yield strength of these alloys. (auth)

8707 DIFFUSION OF OXYGEN IN BETA Ti–21 Mo ALLOY ALONG A TEMPERATURE GRADIENT. Mishra, S. (Bhabha Atomic Research Centre, Trombay, India). pp 431-443 of High Temperature Materials. Bombay; Dept. of Atomic Energy (1972).

From symposium on materials science research; Hyberabad, India (21 Feb 1972). See CONF-720223-.

The diffusion of oxygen was studied in a Ti–21 Mo alloy sample of 18-cm length and 3-mm diameter with a temperature gradient of 22°C/cm. The mean operating temperature was kept at 900°C. The thermotransport experiment carried out for the Ti–Mo binary (contenting less than 0.1 at. % oxygen) by having a temperature gradient of 200°C/cm. The mean operating temperature in this case was kept around 1100°C. Both the experiments were carried out under high vacuum (of the order of 10^{-6} torr). Oxygen was found to diffuse from the high temperature to the lower temperature side of the sample as experimentally observed recently for β-Ti. However, the previous workers failed to get a Q* value (heat of transport) because of the loss of titanium. Titanium loss was avoided in the present experiments. From the electron-microprobe analysis, the hotter end of the 1-cm-long sample was found to be higher in the concentration of molybdenum. Thermotransport experiments conducted by Dübler & Wever on 99.9% pure β-titanium, showed that mass transport is directed against the heat current. The Q* value for β-Ti $\simeq$ 27 kcal/g atom. So the results indicated (earlier) by the microprobe are interpreted accordingly. The approximate heat of transport Q* for the thermomigration of oxygen in the alloy was determined from the plot of oxygen distribution with temperature (in NVS 1/T plot) for 1000 h. The Q* was determined to be about 20 kcal/g atom. The metallographic observation before and after the transport experiment indicated the directional diffusion of oxygen. (auth)

8708 EFFECT OF HYDROGEN SUPPLY TO THE FURNACE ON PROPERTIES OF METALLIC TUNGSTEN. Meerson, G. A.; Kreimer, G. S.; Glushkov, V. N.; Panov, V. S. (Moscow Inst. of Steel and Steel Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 105-110(1972). (In Russian).

The process of reducing WO_3 to W in a muffle furnace by a stream of H_2 was studied at 840 to 900°C. Conditions were established for achieving a homogeneous and small-grained W powder with a specific surface of 0.76 m^2/g and an average grain dimension of 0.5 to 1.5 μ. This W, obtained by H_2 reduction, was used in

the preparation of WC at sintering temperatures of 1450 to 1550°C, which compared favorably with physico-mechanical properties with the industrial equivalent (alloy T15K6). (KSW)

8709 EFFECT OF ALLOYING ELEMENTS ON TEMPERATURE OF THE POLYMORPHOUS TRANSFORMATION OF ZIRCONIUM. Samsonov, G. V.; Braun, S. M.; Rogozinskaya, A. A. (Kiev Polytechnic Inst.). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 118-122(1972). (In Russian).

The effect of the elements Cu, Ni, V, Nb, Ta, Mo, and Al on the temperature of the polymorphous $\alpha \rightarrow \beta$ conversions of iodide Zr was studied. The quantity of the alloying element in no case exceeded its solubility in the α-solid solution in Zr. The effects on the crystal lattice constants of α-Zr were also investigated. All alloying elements with the exception of Al lowered the conversion temperature. Distortion of the crystal lattice of Zr resulted from the presence of the alloying element in the order V → Nb → Ta → Mo for bcc metals, and Al → Cu → Ni for fcc metals. (KSW)

8710 HIGH TEMPERATURE INTERNAL FRICTION IN BORON FIBERS. Dugladze, G. M.; Darsavelidze, G. Sh.; Tsagareishvili, G. V. (Inst. of Metallurgy, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 70: No. 1, 141-144(Apr 1973). (In Russian).

Internal friction of boron fibers from room temperature to 700°C was studied. Relaxation maximum at 380°C with activation energy 2.36 eV was found. The dependence of thermal treatment, fiber diameter, and fiber purity on the height and shape of the maximum was established. The maximum of internal friction is analyzed. (tr-auth)

8711 THERMOEMISSIVE AND ABSORPTIVE PROPERTIES OF THE SYSTEM Ba-Nb. Bekbauliev, B.; Smirnov, B. G. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 52-55(1973). (In Russian).

Barium was sputtered onto a 6.2-mm hemisphere of pure Nb metal at a number of temperatures from 1000 to 1275°K, and the emissive properties of the resulting systems were determined with a thermoelectronic projector. The thermoemission method yielded data on the work function of Nb/Ba films. The heat of adsorption was determined both from Arrhenius lines during the deposition of Ba, and also from the current of the S-curve maxima. (KSW)

8712 PHOTOLUMINESCENCE STUDIES IN IRRADIATED Si-DOPED GALLIUM ARSENIDE. Jeong, M.; Shirafuji, J.; Inuishi, Y. (Osaka Univ., Suita, Japan). Jap. J. Appl. Phys.; 12: No. 1, 109-119(Jan 1973).

In order to reveal the origin of the 1.40- to 1.42-eV band that is peculiar to Si-doped GaAs, elaborate investigations of photoluminescence spectra in irradiated and heat-treated Si-doped samples were carried out mainly at 77 K. All experimental evidences supported the assignment that the band was caused from a complex of Si atoms on As sites with As vacancy. Unidentified emission bands at 1.305 and 1.44 eV were observed respectively in (Te + Si)-doped samples subject to electron irradiation and Si-doped samples fired in a dissociation As pressure. (auth)

8713 TERNARY COMPOUNDS IN THE Zn-Cd-Sb SYSTEM. Kazitsyn, N. V.; Yurkov, V. A. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 6, 65-70(1972). (In Russian).

The phase and chemical compositions, crystal structure, and physical properties were determined for the first time for the ternary, intermetallic compounds Zn_2CdSb_2 and $ZnCd_2Sb_2$. Interplanar distances, crystal lattice types, density, microhardness, electrical resistance, the thermal emf, and Hall's constant all served to confirm the existence of these ternary compounds in the Zn-Cd-Sb system. (KSW)

8714 H-CENTER INTERACTIONS DURING THERMAL ANNEALING IN KBr. Saidoh, M.; Itoh, N. (Nagoya Univ., Japan). J. Phys. Chem. Solids; 34: No. 7, 1165-1171(Jul 1973).

Formation of the V_4 center and the H_A center during thermal annealing in pure and Na^+- and Li^+-doped KBr, x-irradiated at low temperatures, was studied. It was found that these centers are produced, accompanied with the annealing of the H center at the second stage, of which the reaction order was two. The dependence of the concentration of Na^+ impurity on the formation yield of the V_4 center by thermal annealing was studied, and it is shown that the yield of the V_4-center formation is proportional to the square of the concentration of the H-center annealed at the second stage. This result confirms the former di-H-center model of the V_4-center. (auth)

8715 PROPERTIES OF FILMS OBTAINED BY VACUUM SPUTTERING OF PURE METALS AND FRACTIONATING COPPER ALLOYS. Belous, M. V.; Kopol'kov, A. M.; Lysovsa, E. V.; Pavlenko, G. I.; Popov, V. I. Fiz. Khim. Obrab. Mater.; No. 2, 65-69 (1973). (In Russian).

The influence of Te, Mn, Cr, Co, Y, Sb, and Mg on the properties of copper alloy films vacuum-deposited on a support was studied. The properties evaluated were their electrical resistance, structure, weldability, thermal stability, and adhesion to a pyroceramic, and a comparison was made with those of sputtered films of pure Cu, Al, and Co. The optimum composition for vapor deposition, based on the experimental data, which yielded the desired properties was Cu-5% Co-0.5% Mn. (KSW)

8716 REACTION OF TUNGSTEN AND MOLYBDENUM WIRES WITH NICKEL IN A COMPOSITE MATERIAL. Levinskii, Yu. V.; Chubarov, V. M.; Romanovich, I. V.; Dvoichenkova, L. V. Fiz. Khim. Obrab. Mater.; No. 2, 113-119(1973). (In Russian).

The reaction between Ni and W or Mo wires at 1100 to 1250°C was investigated using metallographic and x-ray spectral methods and microhardness measurements. The diffusion coefficients of W and Mo in Ni were determined. The causes of the formation of carbide layers in the wire were established; the effectiveness of carbide layers as diffusion barriers could be discounted. Softening of the Ni-W composition was attributed to a lowering of the recrystallization temperature of the wire owing to the Ni diffusing in it. (tr-auth)

8717 PHYSICO-CHEMICAL REACTIONS NEAR INTERFACES IN FIBROUS COMPOSITIONS WITH A METAL MATRIX. Rybal'chenko, M. K.; Ustinov, L. M.; Bakarinova, V. I. Fiz. Khim. Obrab. Mater.; No. 2, 120-127(1973). (In Russian).

This paper is a survey of the literature on the properties of metallic fibrous compositions and the types of bonding between fiber and matrix. Chemical compatibility of components of such compositions and types of chemical reactions at the fiber/matrix interface are discussed. The wide range of substances concerned include Al/B, Al/C, Al/Be, Ti/B, Ni alloys/W, Cu/W, Cu/Mo, and Ag/W. 31 references. (KSW)

8718 MAGNETIC INTERACTIONS IN METALLIC GADOLINIUM. Burzo, E.; Domsa, F. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 7, 893-896(1972).

The effective exchange parameter in the Hamiltonium describing the electron-ion magnetic interactions in Gd is considered. The values obtained by different methods are discussed and compared with the results of EPR measurements. The effective exchange parameter is calculated on the basis of two density states and from the paramagnetic Curie temperature. The values calculated from the density states are negative whereas those from the paramagnetic Curie temperature are positive. This difference is justified partially by the fact that the exchange interaction is considered a constant, whereas it depends on the difference between the wave vectors before and after the diffusion of the electron by the paramagnetic ion. (JSR)

8719 ACTINIDE(LANTHANIDE)-NOBLE METAL ALLOY PHASES: PREPARATION AND PROPERTIES. Erdmann, B.; Keller, C. (Kernforschungszentrum, Karlsruhe, Ger.). J. Solid State Chem.; 7: No. 1, 40-48(May 1973).

Actinide (A = Th to Cm)-noble metal phases with platinum, palladium, rhodium, and iridium (= B)-and lanthanide-noble metal phases with platinum and palladium were prepared by reduction of corresponding oxides or fluorides in the presence of noble metals by extremely purified hydrogen. Alloy phases of composition AB_2, AB_3, and/or AB_5 were identified, most of which crystallize in the Cu_2Mg, Cu_3Au, Ni_3Ti, Cd_3Mg, Ni_5U, and Pt_5Sm types of structure. The lattice constants of isostructural series show a trend which also is known for the radii of the actinide elements. Analytical data, self-irradiation effects, magnetic data, nuclear γ resonance spectra, and thermal behavior of selected alloy phases as well as the preparation of alloy phases of some other transition and main group elements, e.g., Zr, Hf, Nb, Ta, Mg-Ba, are reported. (auth)

8720 COMPARATIVE STUDY OF THERMAL DIFFUSIVITIES OF STAINLESS STEEL, HAFNIUM, AND ZIRCALOY. Walter, A. J.; Dell, R. M.; Gilchrist, K. E.; Taylor, R. (Atomic Energy Research Establishment, Harwell, Eng.). High Temp.-High Pressures; 4: No. 4, 439-446(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

Thermal diffusivity measurements over the temperature range 300 to 800 K have been made on specimens of stainless steel, hafnium, and Zircaloy-2 using three different models of pulse-heating apparatus. The results obtained using thick specimens (2 mm) were in accord and agreed with literature data. With thinner specimens, however, anomalously low diffusivity values were measured in each laboratory, particularly when using intrinsic thermocouple detectors. Possible explanations for the thickness effect are discussed. (auth)

8721 EXPERIMENTAL INVESTIGATION OF THERMOPHYSICAL PROPERTIES OF LIQUID METALS AT ELEVATED TEM-

PERATURES. Atalla, S. R. (Moscow State Univ.). High Temp.–High Pressures; 4: No. 4, 447-451(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

An apparatus for the simultaneous determination of thermal capacity, diffusivity, and conductivity of liquid metals at 1100 to 2100 K is described. A method of radial temperature waves was used with periodic heating by electron bombardment of the internal surface of a vessel containing the liquid metal. Data obtained for lanthanum, cerium, neodymium, and indium are reported. (auth)

8722 MEASUREMENT OF MELTING POINT, NORMAL SPECTRAL EMITTANCE (AT MELTING POINT), AND ELECTRICAL RESISTIVITY (ABOVE 2650 K) OF NIOBIUM BY A PULSE-HEATING METHOD. Cezairliyan, A. (National Bureau of Standards, Washington, DC). High Temp.–High Pressures; 4: No. 4, 453-458(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

A subsecond duration pulse heating method is used to measure the melting point, normal spectral emittance (at the melting point), and electrical resistivity (above 2650 K) of niobium. The results yield a value of 2750 K for the melting point on the International Practical Temperature Scale of 1968. Normal spectral emittance at the melting point is 0.338, and remained constant during melting. At 2740 K, the electrical resistivity is 90.11×10^{-8} ohm m. Estimated inaccuracy is 10 K in the melting point, 3% in normal spectral emittance, and 0.5% in electrical resistivity. (auth)

8723 THERMAL EXPANSION OF TUNGSTEN FROM 293 TO 1800 K. Kirby, R. K. (National Bureau of Standards, Washington, DC). High Temp.–High Pressures; 4: No. 4, 459-462(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

Measurements on the thermal expansion of three samples of tungsten were made with a twin-microscope method in the range of 1000 to 1800 K. Measurements were also made on one of these samples with a Fizeau interferometer in the range below 1100 K. The results obtained indicated that the values for the expansion of the three samples, two prepared by sintering and one by arc melting, are in reasonable agreement with one another and with some of the data in the literature. (auth)

8724 EXPONENTIAL TEMPERATURE DEPENDENCE OF ELECTRICAL RESISTIVITY OF HCP Hf, Ti, AND Zr ALLOYS. Claisse, F.; Cormier, M.; Frigout, C. (Laval Univ., Quebec City, Can.). High Temp.–High Pressures; 4: No. 4, 395-399(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

The electrical resistivity of hcp Hf, Ti, and Zr alloys can be represented by the expression $\rho_0 + \alpha T/1 + \beta \exp(-E/kT)$. The exponential term is apparently related to a Brillouin zone at a distance E above the Fermi level. It is shown that the parameters β and E depend on the lattice distortion produced by the solute atoms and not on the number of electrons added to or subtracted from the conduction band. (auth)

8725 ELECTRICAL RESISTIVITY OF ZIRCONIUM AND HAFNIUM NITRIDES. Petrova, I. I.; Petrov, V. A.; Ermakov, B. G.; Sokolov, V. V. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 905-909(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 1007-1012 (1972).

The results are given of measurements of the electrical resistivity of stoichiometric zirconium and hafnium nitrides, prepared by precipitation from the vapor phase. The measurements were carried out in the temperature range 1200 to 2500°K. It was found that the electrical resistivity of these materials was much less than that of the materials of the same composition prepared by the powder-metallurgy methods. (auth)

8726 INTERPOLATION EQUATION OF STATE OF TUNGSTEN. Fortov, V. E.; Lomakin, B. N. (Inst. of Chemical Physics, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 1003-1004(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 1118-1119 (1972).

A method for calculating interpolation curves for the equation of state, using tungsten as an example, is given. It is constructed by a procedure from Fortov and Krasnikov, 1970. Experimental data from other sources were used also. It is necessary to construct an equation of state by describing the experimental data on shock compression in the region of low pressures and having a correct asymptotic approach to the Thomas–Fermi model of the "hot" equation of state ($T \neq 0$) at pressures $\gtrsim$100 Mb; in the intermediate region, such an equation of state is interpolated. (JCW)

8727 THERMAL PROPERTIES OF RHENIUM SINGLE CRYSTALS AT HIGH TEMPERATURES. Logunov, A. V. High Temp. (USSR) (Engl. Transl.); 10: No. 5, 889-892(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 988-992(1972).

The results are given of the measurements of the thermal conductivity, the electrical resistivity, and the total hemispherical and spectral ($\lambda = 0.65\ \mu$) emissivity of rhenium single crystals at 1000 to 2800°C. It is shown that the conductivity of rhenium single crystals depends strongly on the orientation. (auth)

8728 ANOMALOUSLY SMALL ELASTIC CURIE CONSTANT OF HYDROGEN IN TANTALUM. Buchholz, J.; Voelkl, J.; Alefeld, G. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev. Lett.; 30: No. 8, 318-321(19 Feb 1973).

We have measured the change in the absolute value and the change in the temperature dependence of the elastic coefficients of Ta, as caused by loading with hydrogen. From the results it must be concluded that, in contrast to heavy interstitials like O, N, or C, hydrogen has a long-range strain field with cubic symmetry in spite of tetragonal symmetry of the position. (auth)

8729 DILATOMETRIC STUDY OF TUNGSTEN–NICHROME COMPOSITION TEMPERATURE STRESSES. Gaiduk, V. V.; Lavrenko, A. S.; Sukhanov, Yu. V. Probl. Proch. Mashinostr.; No. 9, 108-111(Sep 1972). (In Russian).

Internal thermal stresses were determined in compositions incorporating alloy EI435 matrix and tungsten wire by means of an analysis of dilatometric curves of expansion. Stretching stresses were evident in the matrix at low temperatures, and compression stresses at high temperatures. An effect of internal stresses on the mechanical properties of the composition was established. The magnitude and sign of internal stresses in the matrix should be taken into consideration when contemplating the production of items of this composition by bending or stamping. (tr-auth)

8730 ISOTHERMAL TRANSFORMATIONS OF THE $TA_6V_6E_2$ ALLOY CONTAINING 6.4% Zr OCCURRING AFTER THE FORMATION OF β-PHASE SOLID SOLUTIONS. Hourcade, M. (Conservatoire National des Arts et Metiers, Paris). Compt. Rend., Ser. C; 275: No. 21, 1239-1241(20 Nov 1972). (In French).

The $\beta(0)$ phase of a Ti alloy $TA_6V_6E_2$ containing 5.4% Zr decomposes by the $\beta(0) \rightarrow \alpha + \beta$ reaction at temperatures between 900 and 450°C. Below 450°C, isothermal reactions are not observed. However, between 640 and 550°C, the decomposition of the α' martensite formed superimposes itself on the first reaction. Below 550°C, the α' martensite appears to be stable. The extreme hardness observed below 600°C indicates the presence of an ω phase. All the results are represented on a time–temperature–transformation diagram. (FR)

8731 TEMPERATURE DEPENDENCE OF MOESSBAUER SPECTRA OF IRON–COBALT–VANADIUM ALLOYS. Yurchikov, E. E.; Martem'yanov, A. N.; Shtol'ts, E. V. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 35: No. 1, 194-196 (1973). (In Russian).

Several alloys with 52% Co, 8 to 15% V, and the remainder Fe were used to obtain Moessbauer spectra at 20 and –170°C. A significant increase in magnetizing saturation at low temperatures was obtained for the alloys with larger concentrations of V. The temperature dependence of the Moessbauer spectra of the γ-phase of the alloys in deformed and tempered states showed that these alloys with 11 to 15% V in the tempered state were paramagnetic over the temperature interval from liquid nitrogen to room temperature. (KSW)

8732 CYCLIC BAUSCHINGER EFFECT ON THE BOUNDARIES IN MECHANICAL TWINNING OF BERYLLIUM. Bashmakov, V. I.; Bosin, M. E.; Papirov, I. I. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 35: No. 1, 220-221 (1973). (In Russian).

The change in Bauschinger's effect with the number of deformation cycles was studied in crystals of Be. The relative changes in creep limits of twinned boundaries with the number of cycles of alternating loading was measured during a regime of increasing stress for the Be crystals. As a result of the cold working the limits of creep increased and the Bauschinger effect was noticeably weakened during 8 to 10 cycles. (KSW)

8733 ELECTRON-MICROSCOPE INVESTIGATION OF THE STRUCTURE OF SUPERCONDUCTING WIRE OF 60T ALLOY. Lazarev, B. G.; Kogan, V. S.; Martynov, I. S.; Seryugin, A. L. (Moscow Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 35: No. 1, 221-224(1973). (In Russian).

A study was made of the correlation between the structure of a Nb–Ti wire in the original state and after different thermal histories, and also between the corresponding values of the critical

current. A 60T alloy (Ti–40 at. % Nb) wire 0.25 mm in diameter was etched in $HF–HNO_3–H_2O$ and then annealed for 1 to 2 hr at 400, 550, and 700°C. The correlation between the critical current of the alloy and its microstructure following these treatments is discussed. (KSW)

8734 FREE SURFACE ENERGY OF ZIRCONIUM IN THE SOLID PHASE. Kostikov, V. I.; Kharitonov, A. V. (Moscow Inst. of Steel and Alloys). Fiz. Metal. Metalloved.; 35: No. 1, 188-189(1973). (In Russian).

Samples prepared from iodide zirconium were used to measure the relative elongation as a function of loading during an annealing period. The annealing time was a contributing factor to the resulting elongation characteristics. From the data obtained, the surface energy of Zr at 1800°C was found to be 1850 ergs/cm^2. (KSW)

8735 FIELD-ION-MICROSCOPIC STUDY OF THE HIGH-SPEED DEFORMATION OF TUNGSTEN. Afanas'ev, V. I.; Garber, R. I.; Levandovskii, B. I. Fiz. Metal. Metalloved.; 35: No. 1, 192-194(1973). (In Russian).

The high-speed deformation of tungsten VA-3 was studied with a field ion microscope, using a metallo-ceramic W wire about 0.1 mm in diameter and 6 cm long. Information on the slippage planes of the W was obtained and is discussed. (KSW)

8736 INFLUENCE OF DEFORMATION AND HEAT TREATMENT ON THE STRUCTURAL CHANGES OF ALLOY OKh12N13M. Gruzin, P. L.; Raevskaya, M. N.; Rodionov, Yu. L.; Mkrtchyan, V. S. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Fiz. Metal. Metalloved.; 35: No. 1, 157-162(1973). (In Russian).

The influence of deformation and annealing on the redistribution of atoms in the alloy Fe–12 Ni–11 Cr–2 Mo was studied. The effect on Fe atoms that had differing numbers of Cr atoms in their neighborhoods was determined. The phase composition of the alloy after quenching, deformation, and subsequent annealing was ascertained. (tr-auth)

8737 PREDICTION OF LAVES PHASES WITH AN ELECTRONIC COMPUTER. Sabitskii, E. M.; Gribulya, V. B. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 206: No. 4, 848-851(1 Oct 1972). (In Russian).

A method is proposed for predicting metallic compounds with Laves phase structures with specific physical properties (magnetic, electrical, etc.) that preserve the characteristics of metallic substances. An algorithm previously written for the authors (1971) for the Minsk-22 computer is used, the essence of which was the selection of criteria from among conflicting classes in which were grouped examples of the presence and absence of Laves phases. Discussion is centered around families of the Periodic Table with special reference to compounds such as Nb_2Tc, AlB_2, and A_2Cd (where A = Nb, Mo, Tc, Ru, Rh, Pd, Ag), and Rb_2B (where B = Sn, Y, Zr). (KSW)

8738 PHASE COMPOSITION DIAGRAM FOR THE NIOBIUM–TIN SYSTEM. Matsakova, A. A.; Lazarev, B. G. (Physical Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 35: No. 1, 148-156(1973). (In Russian).

Temperature boundaries for the compounds Nb_6Sn_5 and $NbSn_2$ were more accurately determined for the Nb–Sn phase composition diagram using samples prepared by a thermo-diffusion method under static conditions. Superconducting properties and microstructure data aided in this determination. The dependence of the thickness of Nb_3Sn layers on the time and temperature of preparation and the activation energy of this intermetallide were ascertained. (tr-auth)

8739 CAST STEELS FOR NUCLEAR REACTORS. del Villar, A. Sulzer Tech. Rev.; No. Nuclex 72, 114-123(1972).

The present state of the art regarding the principal requirements from steel castings for the primary circuit of water-cooled reactors is discussed. Prime importance attaches to the prevention of the corrosion processes causing coolant contamination, as well as operational safety and environment conservation. The requirements can be satisfied either with corrosion-resistant austenitic cast steels or with cladded ferritic grades. The potentialities and limitations of these material groups are presented and explained, drawing on test results and examples from production. (auth)

8740 DIFFUSION BEHAVIOR OF TUNGSTEN LAYERS ON MOLYBDENUM EMITTERS OF IN-CORE THERMIONIC REACTORS. Peehs, M. Siemens Forsch.-Entwicklungsber.; 1: No. 2, 61-70(1971). (In German).

The Mo–W binary system is discussed with regard to the respective diffusion coefficient of the two metals. The bulk-diffusion coefficient of Mo in Mo–W mixed crystals was determined by experiments in which diffusion couples were produced by the chemical vapor-deposition of W on sintered Mo from pyrolyzed $W(CO)_6$ or by the H-reduction of WF_6. The bulk-diffusion coefficient of Mo in W increased with the temperature. At high temperature, bulk diffusion predominates, whereas up to 1970°K, the diffusion in the boundary zone and W layer is determined by the microstructure. Below 1970°K, grain-boundary diffusion predominates. The diffusion mechanism is discussed. (Metals Abstr.)

8741 STABILITY OF METAL-BASE COMPOSITE MATERIALS. Karpinos, D. M.; Tuchinskii, L. I.; Vishnyakov, L. R. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 3, 65-70(Mar 1973). (In Russian).

The structural stability of hot-pressed 0.5- to 1-mm-diameter tungsten fibers in the ternary system Ni–Cr–W was investigated. The dissolution kinetics for W fibers in ternary matrix alloys of a variety of compositions were studied. If the composition of the matrix was located near the limiting solubility line at a given temperature, dissolution of the fiber did not occur. (KSW)

8742 DESIGN, MANUFACTURE, AND TEST OF HOT STRUCTURE. Bergmann, H. W.; Rowe, J. pp 481-93 of 18th National SAMPE Symposium and Exhibition. Vol. 16. Azusa, CA; Society for the Advancement of Material and Process Engineering (1973).

From symposium on new horizons in materials and processing; Los Angeles, California, USA (3 Apr 1973). See CONF-730422-.

A hot-structure concept for thermal environments between 600 and 1600°F was developed and applied to an orbiter elevon. A full-scale section of the elevon was manufactured and tested at elevated temperatures. The test specimen contained ribs and spars consisting of flat René 41 caps which were burn-through welded to corrugated webs, and sandwich-type cover panels of René 41 and 6 Al-4V titanium. The test results indicated that the design concept is basically sound. (auth)

8743 L-SHELL AUGER ENERGIES AND INTENSITIES IN 3d TRANSITION METALS. Phillips, J. D. Atlanta; Georgia Inst. of Tech. (1972). 207p. University Microfilms Order No. 73-6484. Thesis (Ph. D.).

A theoretical investigation was conducted of LMM Auger transitions in the elements Ti, V, Cr, Zr, Nb, and Mo. Results are in the form of LMM Auger transition probabilities and energies. All calculations were performed in the framework of the nonrelativistic theory of the Auger effect due to Wentzel. Although molecular and solid-state effects were ignored in the calculations, their contribution is considered. In order to achieve the most reliable values for the transition probabilities, the pertinent electron wave functions were obtained by the Hartree–Fock approach to the atomic problem using the procedure developed by C. F. Fischer. Separate Hartree–Fock calculations were carried out for each possible initial and final state in order to account for the "relaxation" of the electron orbitals during the transition. To provide the most general formulation of the problem, the computations were performed in the formalism of intermediate coupling (IC). One conclusion is that it is unnecessary to use the IC limit when treating LMM transitions in Ti, V, and Cr; it is a necessity, however, in Zr, Nb, and Mo. The energy calculations were accomplished by first computing the total energies of the initial and final atomic states for each transition. The difference of these is, by conservation of energy, the energy of the Auger electron. In order to insure that the multiplet spectra obtained by this approach are in agreement with that predicted on the basis of the Wentzel theory, two distinct methods—the spectator and "exact"—were developed to compute the total energies. The spectator approach is used for all atoms with an incomplete M atomic shell; it was therefore used for the (Ti, V, Cr) calculations. If the M shell is completely filled, then the "exact" method is utilized. Results are given in tabular form and compared with available experimental data. Due to a severe shortage of such data for LMM transitions, this comparison did not provide a meaningful test of the calculations. (DLC)

8744 PENDULUM IMPACT RESISTANCE OF TUNGSTEN FIBER/METAL MATRIX COMPOSITES. Winsa, E. A.; Petrasek, D. W. (Lewis Research Center, Cleveland). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 350-362(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

The impact properties of copper, copper–10 nickel, and a superalloy matrix reinforced with tungsten fibers were studied. In most cases the following increased composite impact strength: increased fiber or matrix toughness, decreased fiber-matrix reaction, increased test temperature, hot working, and heat treatment. Notch sensitivity was reduced by increasing fiber or matrix toughness. The effect of fiber content depended on the relative toughness of the fibers and matrix. Above 530°K, a 60 vol. % superalloy

matrix composite had a greater impact strength than a turbine blade superalloy whereas, below 530°K, a hot-worked 56 vol. % composite had a greater impact strength than the superalloy. (auth)

8745 OFF-AXIS AND TRANSVERSE TENSILE PROPERTIES OF BORON-REINFORCED ALUMINUM ALLOYS. Swanson, G. D.; Hancock, J. R. (Midwest Research Inst., Kansas City, MO). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 469-482(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

Tension specimens of boron reinforced 7075 and 6061 aluminum were tested at angles of 0, 30, and 90° to the unidirectionally aligned filaments. Metallurgical structures in the matrix and at interfaces were correlated with stress-strain curves, with acoustic emission from boron filament breakage during the tests, and with fractographic studies. Differences in composite strength after various heat treatments were attributed to changes in the properties of the matrix rather than to any difference in properties of the filament-matrix interface. Transmission electron microscopy of boron/7075 aluminum composites revealed (1) precipitate segregation to interfaces for all heat treatments, (2) that subzero thermal treatments provide a new means of developing desired microstructures in composites, and (3) the presence of a narrow surface layer in the filaments in boron/7075 aluminum composites. This surface layer is believed to be a result of diffusion during composite fabrication. (auth)

8746 INITIATION AND GROWTH OF FATIGUE CRACKS IN FILAMENT-REINFORCED ALUMINUM ALLOYS. Hancock, J. R. (Midwest Research Inst., Kansas City, MO). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 483-502(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

The low-cycle fatigue behavior of filamentary composites of beryllium/1235 aluminum, beryllium/6061 aluminum, and boron/7075 aluminum were compared. The effects of the strength and ductility of the filaments and matrix, and the role of interfaces on fatigue crack initiation and growth were evaluated to develop guidelines for the design of fatigue resistant composites. Generally, brittle filaments, a low yield strength ductile matrix, weak interfacial bonds, and a large modulus difference between constituents are the factors which lead to greater fatigue resistance in filament reinforced metals. The observed modes of fatigue crack growth confirmed the theoretical predictions of the effects of stress distribution at a crack tip at an interface and extended the applicability of these predictions to filamentary composites. (auth)

8747 REQUIRED CRITICAL ASPECT RATIO OF FIBERS INTENDED FOR STRESS-RUPTURE APPLICATIONS. Jech, R. W. (Lewis Research Center, Cleveland). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 516-524(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

The observed critical aspect ratio for pullout specimens of tungsten wire in a copper matrix tested in stress rupture at 649 and 816°C was slightly greater than for tension tests at the same temperature. Time for failure of the stress-rupture specimens was controlled by the properties of the fiber (tungsten) at aspect ratios greater than the critical aspect ratio and by the properties of the matrix (copper) at aspect ratios less than the critical ratio. (auth)

8748 PHASE TRANSFORMATIONS IN VICALLOY-1 ALLOY. Zel'dovich, V. I.; Samoilova, E. S.; Doposhenko, A. V. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 35: 125-133(1973). (In Russian).

A study was made of the phase conversions in the alloy Vicalloy-1 (Co–37.4% Fe–10.5% V–0.05% C) during heating as high as 1000°C and subsequent cooling. Dilatometric measurements, lattice constants (420 to 760°C), magnetizing saturation, and the coercive force were all investigated as functions of the temperature. (KSW)

8749 SCANNING ELECTRON MICROSCOPE STUDY OF LASER-DAMAGED BERYLLIUM THIN FILMS. Murr, L. E. (Department of Metallurgical and Materials Engineering, New Mexico Institute of Mining and Technology, Socorro, New Mexico 87801); Payne, R. T. J. Appl. Phys. 44: No. 4, 1722-1726 (Apr 1973).

Laser damage in Be films vacuum vapor deposited onto polished glass substrates was investigated in the scanning electron microscope. Surface scratches were observed to raise thermal gradients and promote premature melting and film degradation in Be films 0.1–0.3 μ thick for beam intensities of 40–55 MW. The damage zones were characterized by radially symmetric melting and evaporation consistent with a cross-sectional distribution of laser-beam energy. The results indicate that vaporization contributes prominently to Be film degradation by laser-beam irradiation. (auth)

8750 PRESSURE DEPENDENCE OF THE CURIE TEMPERATURE OF INTERMETALLIC COMPOUNDS OF IRON AND RARE-EARTH ELEMENTS, TH AND ZR. Brouha, M.; Buschow, K. H. J. (Philips Research Laboratories, Eindhoven, Netherlands). J. Appl. Phys. 44: No. 4, 1813-1816 (Apr 1973).

The pressure dependence of the Curie temperature (T_c) of several intermetallic compounds of iron has been determined by means of the temperature dependence of the electrical resistivity at various pressures. Pressures up to 40 kbar were applied. The value of dT_c/dp was observed to be negative in the compounds R_2Fe_{17} (R = Pr, Nd, Er, and Th), Y_6Fe_{23}, Er_6Fe_{23}, $ErFe_3$, TH_2Fe_7, $ThFe_3$, $CeFe_2$, and $ZrFe_2$. The Curie temperature of the compound $ThFe_5$ is pressure independent within experimental error. In the compounds RFe_2 (R = Gd, Ho, Er, and Y), the value of dT_c/dp was found to be positive. The experimental data are discussed in terms of Friedel's semilocalized model and the collective electron model. (auth)

8751 MAGNETIC PROPERTIES OF DYCD AND RELATED CSCL-TYPE COMPOUNDS. Buschow, K. H. J. (Philips Research Laboratories, Eindhoven, The Netherlands). J. Appl. Phys. 44: No. 4, 1817-1820 (Apr 1973).

The magnetic properties of the compounds DyCd, DyZn, and some ternary compounds $DyCd_{1-x}Zn_x$ have been studied. At 4.2 K the compound DyCd shows a field dependence of the magnetization characterized by a strong increase for fields higher than 15 kOe. This increase of the magnetization is not reversible but is accompanied by a large hysteresis without involving a remanent magnetization. This behavior has been explained by a model in which DyCd is considered to be a ferromagnet in which a special type of lattice imperfection can provide sites of easy nucleation and/or strong Bloch wall pinning. (auth)

8752 TRANSFORMATION IN CRYSTALLINE BORON DURING MECHANICAL DISPERSION. Tsomaya, K. P.; Samsonov, G. V.; Tavadze, F. N. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 3, 83-92(Mar 1973). (In Russian).

An effect of fine mechanical dispersion was studied as applied to phase composition of boron obtained by different methods. It was established that at a fine dispersion of boron obtained by depositing from a gas phase (BBr_3) and of the phase components is amorphized. An assumption is made that an unstable readily amorphized phase, found for the first time, is a boron modification constructed of atoms with least energetically stable s^xp^y configurations (s^2p, sp). (auth)

8753 EFFECT OF PRIMARY CRYSTALS OF INTERMETALLIC COMPOUNDS ON THE PROPERTIES OF MAGNESIUM ALLOYS. Chuprakova, M. V. Tsvetn. Metal.; No. 3, 68(Mar 1973). (In Russian).

The presence of intermetallides affected the mechanical properties of rolled and pressed fabricated products based on Mg. The intermetallic compounds referred to include Zr, Mn, Al, and Fe. (KSW)

8754 METALLURGICAL INVESTIGATIONS OF PHASE EQUILIBRIA IN THE TITANIUM–NIOBIUM–GERMANIUM TERNARY SYSTEM. Heller, W. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Z. Metallk.; 64: No. 2, 124-128(1973). (In German).

The titanium–niobium–germanium ternary system was investigated in the titanium- and niobium-rich region. The intermetallic compounds Ti_5Ge_3, Nb_5Ge_3, and Nb_3Ge form equilibria with the β and α phases of the titanium–niobium system. Ti_5Ge_3 and Nb_5Ge_3 exhibit a pronounced solubility for niobium and titanium; however, complete miscibility does not occur. The solubility of germanium in the commercial superconducting alloy TiNb 50 was found to be 2.3% Ge at 1100°C and less than 0.25% Ge at 700°C. (GE)

8755 EFFECT OF SUBSTRUCTURE AFTER DEFORMATION ON PROPERTIES OF METALS. Schlaubitz, K.; Mueller, D.; Gueth, A. Banyasz. Kohasz. Lapok, Kohasz.; 105: No. 6, 257-260(Jun 1972). (In Hungarian).

There is a definite relationship between the substructure after deformation and mechanical properties of Mo single crystals. The difference in the recrystallization temperature of single crystals or different orientation is explained by the distribution of dislocations. (Metals Abstr.)

Radiation Effects

Refer also to abstracts 8564, 8572, 8573, and 10123.

8756 (AD-755147) RIP (RADIATION INTERACTION PROGRAM), A ONE-DIMENSIONAL MATERIAL RESPONSE CODE. Fisher, R. H.; Read, H. E. (Systems, Science and Software, La Jolla, Calif.). Sep 1972. Contract DASA01-70-C-0055. 100p. (SSS-R-72-1324; DNA-2993-F). NTIS.

The Radiation Interaction Program (RIP) was developed and documented as part of the DNA-sponsored PREDIX Program. RIP is a one-dimensional slab geometry, material response code. This code is used to calculate the response of homogeneous materials exposed to x-ray radiation, electron beams, plate impact, or an arbitrary time-dependent pressure boundary condition. The report contains a general description of the code, its available options, and descriptions of the primary physical models. In particular the x-ray radiation source routine, equations of state, a rate-dependent strain hardening constitutive model for 6061-T6 aluminum (which also includes a Bauschinger effect on unloading), and material failure models are discussed. (auth)

8757 (BAW-10056) RADIATION EMBRITTLEMENT SENSITIVITY OF REACTOR PRESSURE VESSEL STEELS. Palme, H. S. (Babcock and Wilcox Co., Lynchburg, VA. (USA). Nuclear Power Generation Div.). Mar 1973. 54p.

A literature survey covering the effects of residual elements on the neutron embrittlement sensitivity of pressure vessel steels shows that the copper and phosphorus contents largely control radiation embrittlement. The roles of copper, phosphorus, sulfur, vanadium, nickel, aluminum, and nitrogen were reviewed and are explained in terms of the Charpy V-notch 30 ft-lb transition temperature shift, the reduction of the Charpy upper shelf, and the increase of the yield strength. Vanadium, nickel, aluminum, and nitrogen are identified as playing minor roles in the sensitivity, and sulfur is identified as an element primarily affecting the material's initial upper shelf energy level. Through specification of the composition, B&W now uses pressure vessel steels that are predicted to be essentially insensitive to significant radiation embrittlement under normal conditions of nuclear service. Design curves for 550°F are established showing the effects of neutron fluence and of copper and phosphorus contents on the material's reference temperature, RT_{NDT}. (8 figures, 42 references) (auth)

8758 (EURFNR-1061) INFLUENCE OF COLD WORK ON THE CORROSION RESISTANCE OF AUSTENITIC CrNi STEELS IN SUPERHEATED STEAM. 2. Static Autoclave Studies on Incoloy 800 in Different Grain Sizes. Leistikow, S.; Pott, E. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Dec 1972. 28p. (KFK-1681). Dep. NTIS $3.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Using Incoloy 800 sheet specimens of different grain sizes the extent and oxide formation by superheated steam corrosion attack in dependency of cold deformation was tested. Sheet specimens of three different grain classes (50 to 100, 100 to 150, 150 to 300 μm) were produced by heat treatments in argon at 1050, 1150, and 1300°C and by cold rolling to 10, 30, 50, 70, 85, and 90% of the original thickness. In the electropolished condition these sheet specimens were tested during 1000 hours at 600°C and 70 atm in autoclaves. In general, the experiments resulted in a reduction of corrosion related to the increasing cold work. The grain size dependent differences in corrosion behavior, still existing until high degrees of cold work, are gradually reduced so that the bands of values attributed to the different grain classes are converging to minimum corrosion values of 25 to 50 mg/dm^2 metal loss. The results are explained in the case of lower degrees of cold work as effect of increasing dislocation density in the bulk structure on chromium diffusion and oxidation. For higher degrees of cold work the results show the effect of grain refinement and increased grain boundary concentration per surface unit. The increased defect concentration favored the diffusivity of chromium to selective oxidation, and protective oxide scale formation. In consequence for practical applications, local coarse grain structures of materials such as Incoloy 800 will react with oxidizing gases more extensively than fine grain structures. The effect of grain size on the extent of corrosion attack can be eliminated by extensive cold deforming surface pretreatments. (auth)

8759 (ORNL-TM-4105, pp 3.1-3.61) MECHANICAL PROPERTIES OF ALLOYS IN REACTOR ENVIRONMENTS AND DEVELOPMENT OF FAST REACTOR CLADDING AND STRUCTURAL ALLOYS. May 1973.

In fuels and materials development program quarterly progress report.

A test program for the evaluation of the properties of a commercial double-vacuum melted heat of titanium-modified type 316 stainless steel has been outlined. Microstructural studies in support of the tubing fabrication have continued and tensile and creep rupture tests on unirradiated rod have been initiated. Transmission electron microscopy examination of austenitic stainless steel specimens irradiated in EBR-II subassembly X100 has continued. Comparison of the irradiation-induced swelling in high-purity and commercial-purity type 316 stainless steels and in commercial-purity type 316 stainless steels containing titanium additions demonstrates that carbon and possibly silicon in solution significantly reduce swelling of the base Fe, Cr, Ni, Mo composition. Microstructural studies on irradiated stainless steel fuel cladding have continued. Swelling, as determined by transmission electron microscopy measurements was approximately a factor of 2 lower than required to account for the observed diameter increase. It is concluded from examination of the dislocation structures that deformation has not occurred through the motion of glide dislocations. Preferential nucleation and/or growth of loops on planes situated to relieve stresses cannot be eliminated as a deformation mechanism. An Auger Electron Spectrometer has been modified to allow the in situ testing of highly irradiated austenitic stainless steel samples. The chemical composition of the fracture surfaces can thus be determined. Initial studies are being conducted on samples of annealed type 304 stainless steel from EBR-II safety rod thimble 3Al. Specimens irradiated to fluences of 1.4, 4.7, and 10.0×10^{22} neutrons/cm^2 (>0.1 MeV) have been fractured at 550°C. The samples irradiated to 4.7 and 10×10^{22} neutrons/cm^2 failed along grain boundaries while the sample irradiated to the lower fluence failed by both inter- and transgranular fracture. Helium was released from the samples as the fractures occurred. The amount of helium released correlated with the neutron fluence. Grain boundaries contained relatively large P and S concentrations and the Cr/Fe and Ni/Fe ratios were different than expected from the bulk composition. (auth)

8760 VOID FORMATION IN STABILIZED STEELS AFTER BOMBARDMENT WITH 20 MeV C^{2+} IONS. Ehrlich, K.; Gross, R. (Kernforschungszentrum, Karlsruhe, Ger.). (1972). 11p. (In German).

From general meeting of the Deutsche Gesellschaft fuer Metallkunde; Stuttgart, Germany (23 May 1972).

The steel samples numbers 1.4988, 1.4981 and 1.4970 were first homogeneously implanted with α-particles on a 10 atom ppM helium/lattice atom at room temperature. The samples were then irradiated with C^{2+} ions, an energy of 20 to 21 MeV, corresponding to a neutron dose of 8 to 9×10^{22}n/cm^2 (E > 0.1 MeV). Regions of homogeneous damage were achieved at a sample depth of 5 to 7 μm, which were microscopically examined. The dependence of the swelling data on the irradiation temperature is presented and compared with the AISI-316 steel data. (GF)

8761 EFFECT OF DEOXIDATION OF MALLEABLE IRON ON THE GRAPHITIZING INFLUENCE OF NEUTRON IRRADIATION. Mitter, W.; Koss, P. Giessereiforschung; 23: No. 4, 147-149(1971). (In German).

Neutron irradiation of white iron before annealing facilitates the precipitation of temper graphite in specimens deoxidized before casting. This does not occur in oxidized specimens and is regarded as due in that case to the filling of lattice vacancies by O, thereby denying them to graphite nuclei. (Metals Abstr.)

8762 INVESTIGATION OF SURFACE CHANGES INDUCED BY ION BOMBARDMENT. Navinsek, B. (Josef Stefan Inst., Ljubljana, Yugoslavia). pp 221-252 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

Surface topography changes observed on ion-bombarded solids were analyzed. Surface features were studied from the total ion dose point of view, as an attempt to bring all topography changes on to one scale. This scale was divided roughly into three regions: indirectly detectable damage on the atomic scale (doses 10^{11} to 10^{15} ions/cm^2), visible damage on the microscopic scale (doses 10^{15} to 10^{17} ions/cm^2), and well-developed surface structures leading to an equilibrium on the macroscopic scale (doses larger than 10^{17} ions/cm^2). It was shown that the main parameters involved in the development of surface topography during ion bombardment are: the initial surface state, the crystal structure of the solid, the angle of ion incidence, the focusing and channeling effect, the total ion dose, and damage formation. Among them, three parameters could be critical in most cases: the critical ion dose (between 5×10^{16} and 5×10^{17} ions/cm^2) where the surface structure is changed so much that all surface-dependent processes are significantly changed (sputtering yield, penetration, focusing, surface diffusion, etc.); the critical angle of incidence, where the sputtering yield has the maximum value, and the initial state of the bombarded surface. Modern techniques like LEED, scanning and transmission electron microscopy enable one to follow the development of surface structure in situ and in very clean conditions. Much more experimental work has to be done on single-crystal targets in well-determined and widely varying sputtering conditions, and

especially on the correlation between the damage in bulk and the surface topography, before the surface changes induced by ion bombardment will be better understood. (23 figures, 83 references) (auth)

8763 MEASUREMENT OF RANGE PROFILES. Whitton, J. L. (Chalk River Nuclear Labs., Ont.). pp 283-304 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

Techniques for measuring range profiles are described, a critical assessment of their usefulness is made, and recommendations are made for the use of them. These techniques include sectioning methods (dissolution, stripping, sputtering, vibratory polishing) and methods for detection of implanted atoms. (9 figures, 46 references) (DLC)

8764 DIRECTIONAL EFFECTS IN RADIATION-INDUCED DAMAGE: IONS. Chadderton, L. T. (Univ. of Copenhagen). pp 305-347 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

Selected aspects of radiation damage in single crystals are discussed, particularly directional effects arising out of the systematic arrangement of atoms in the lattice. After a consideration of defects and the slowing-down process, channeling and focusing are discussed. Some experimental data are given, and use of channeling as a tool is considered. (17 figures, 52 references) (DLC)

8765 DEFORMATION OF SINGLE CRYSTALS OF BERYLLIUM UNDER THE INFLUENCE OF LASER RADIATION. Papirov, I. I.; Abotin, S. S.; Krivchikova, E. P.; Kornienko, L. A. Fiz. Khim. Obrab. Mater.; No. 2, 147-148(1973). (In Russian).

Single crystals of Be with orientations (0001) and (1120) were obtained by zone melting and subjected to pulsed laser radiation. Evidence was obtained of strong plastic deformation. Twins in the deformation zone possessed strongly cut faces and a fused surface. Many twins of a tetrahedral form were observed, formed by microtwins. Traces of transverse slippage and cracks along the surface were noted. (tr-auth)

8766 RADIATION BLISTERING IN NIOBIUM. Donhowe, J. M. (Univ. of Wisconsin, Madison); Klarstrom, D. L.; Sundquist, M. L.; Weber, W. J. Nucl. Technol.; 18: No. 1, 63-66(Apr 1973).

Pure niobium foils irradiated with 300-keV D^+ ions at 550, 650, and 700°C developed blisters visible in a scanning electron microscope. Samples irradiated at temperatures below 550°C produced no visible blisters. (auth)

8767 RADIATION EFFECTS IN TUNGSTEN MONOCARBIDE. Koval'chenko, M. S.; Rogovoi, Yu. I. Fiz. Metal. Metalloved.; 35: No. 1, 64-70(1973). (In Russian).

The microstructure, lattice parameters, electrical resistance, and microhardness of WC were significantly altered by neutron bombardment in fluxes as low as 3.7×10^{19} neutrons/cm^2. A recovery of the lattice parameters and properties during isochronous annealing of the irradiated WC occurred in three steps: 180, 380, and 570°C. An interpretation of these three stages is offered on the basis of a recombination of internodal atoms of C and W with vacancies. (KSW)

8768 ANNEALING OF EFFECTS ARISING FROM ALLOYING OF METALS BY IONIC BOMBARDMENT WITH ENERGIES UP TO 10 keV. Pugacheva, T. S.; Sharakhmedova, M. Sh.; Kasymov, A. Kh. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 56-59(1972). (In Russian).

The effects of temperature on the results of implantation of 10-keV metallic ions (Mg) in the surface of a metal of a different species (Ni) was studied. The thickness of this "alloyed" layer did not exceed 100 to 200 Å, and was further measured as a function of time while holding the system at 500°K. The annealing time was a function of the energy of the bombarding ions while maintaining the system at 900°K. (KSW)

8769 NEUTRON-IRRADIATION EFFECTS ON A METAL–MATRIX COMPOSITE. Kvam, K. C.; Jones, R. C. (Massachusetts Inst. of Tech., Cambridge). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 525-538(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

Effects of nuclear irradiation on the mechanical properties of a metal matrix composite were examined to update composite theory to include nuclear effects and to determine the feasibility of nuclear applications of metal-matrix composites. An NS 355 stainless steel fiber/2024-T6 aluminum matrix composite was cut into specimens which were then divided into four sample groups. Three of these groups were irradiated to fast neutron dosages of 1.56, 2.84, and 4.68×10^{18} neutrons/cm^2. Microhardness and flexure tests were performed on each of the four sample groups. Fracture surfaces of all sample groups were viewed by scanning electron microscopy. Strength increases and ductility decreases with increasing dosages are generally observed in the aluminum matrix and the stainless steel fibers. The high degree of matrix hardening and subsequent saturation with increasing dosage, leading to changes in the relative failure strain of matrix and fiber, are identified as the controlling mechanism of the composite strength changes in flexure. Existing composite theory is concluded to be applicable to nuclear irradiated composites without modification. (auth)

8770 ACCELERATOR STUDY OF VOID PRODUCTION IN MOLYBDENUM. Evans, J. H. (Atomic Energy Research Establishment, Harwell, Eng.). Radiat. Eff.; 17: No. 1-2, 69-81 (Jan 1973).

Irradiation damage in molybdenum at temperatures between 400°C and 900°C was investigated, the displacement damage being produced by 2-MeV nitrogen ions from a Van de Graaf accelerator. Part of the study was aimed specifically at obtaining void data in molybdenum and results are given of an examination of the temperature range over which void formation becomes appreciable together with an examination of the variation of void swelling with dose. These results are extrapolated to neutron environment dose rates and indicate that molybdenum is particularly resistant to void swelling in the operating range of the sodium-cooled fast breeder reactor. The high void concentrations found in molybdenum are thought to be important in this context and a simple theory is developed to demonstrate this point. Other experimental results are described and include a brief account of the void superlattice formation, a study of the dislocation substructures as a function of temperature and dose including some unexpected vacancy loop observations, a note on the production of voids during post-irradiation annealing, some qualitative results of the effect of high helium concentrations on void swelling, and a short account of self-ion irradiations with a result demonstrating one of the possible drawbacks of such irradiations. In addition, some general comments are made on accelerator irradiations and the role of the bombarding ion, with particular reference to the nitrogen–molybdenum system used in this work. (auth)

8771 DOSE DEPENDENCE OF VOID SWELLING IN 18/8/Ti STAINLESS STEEL IRRADIATED WITH 20-MeV C^{++} IONS AT 600°C. Williams, T. M. (Atomic Energy Research Establishment, Harwell, Eng.). Radiat. Eff.; 17: No. 1-2, 49-55(Jan 1973).

Fast-neutron-induced voidage was simulated in solution-treated and in 20%-cold-worked 18/8/Ti stainless steel using 20-MeV C^{++} irradiations in the Harwell Variable Energy Cyclotron. Foils containing 10^{-5} helium atoms per atom were irradiated at 600°C to 5, 10, 20, 40, 60 and 120 displacements per atom. The void swelling at each dose was determined from the volume of the voids observed by transmission electron microscopy. In solution-treated steel the void swelling was approximately proportional to dose over a large part of the dose range studied; in 20% cold-worked steel the swelling was proportional to $(\text{dose})^2$ in the same dose range. In both cases there was evidence of saturation at doses ≥ 60 d.p.a. The void swelling was lower in 20% cold-worked than in solution-treated steel at all doses, but the difference diminished with increasing dose. (auth)

8772 LOW-DENSITY APPROXIMATION FOR DIFFUSION ANNEALING. Schroeder, K. (Kernforschungsanlage, Juelich, Ger.). Radiat. Eff.; 17: No. 1-2, 103-118(Jan 1973).

The problem of annealing of Frenkel pairs in electron-irradiated fcc metals due to diffusion of interstitials is treated, starting from exact equations for single particle densities, pair densities, etc. The mobile interstitials are considered to interact with vacancies (leading to recombination), impurity atoms (leading to interstitial-impurity complexes) and with each other (leading to interstitial clusters). By using the superposition approximation, i.e., replacing three-particle probabilities by products of two-particle probabilities, generalized Waite equations are obtained. For low defect densities the annealing is at different times governed by different processes. For short times the important process is the recombination of an interstitial with the nearby correlated vacancy generated by the same electron impact event, the so-called correlated recovery. For long times the remaining interstitials undergo long range migration and interact with uncorrelated sinks. During this process interstitial impurity complexes and interstitial clusters are formed. The time dependence of the defect densities, the remaining fraction of defects after completion of diffusion annealing and the size distribution of interstitial clusters are calculated. Comparison is made with experiments in Cu and Pt. (auth)

8773 ENERGY DEPENDENCE OF THE DEFECT PRODUCTION AT 93 K IN ELECTRON-IRRADIATED COPPER. Becker, D. E.; Dworschak, F.; Wollenberger, H. (Kernforschungsanlage, Juelich, Ger.). Radiat. Eff.; 17: No. 1-2, 25-30(Jan 1973).

The ratio of the cross sections for defect production at 93 and 8°K irradiation temperatures was measured as a function of electron energy between 0.4 and 3.2 MeV. This ratio amounts to 0.4 and does not depend on energy within the energy range investigated. From this result and the well-known energy dependence of the fraction of close-pair annealing, the energy dependence of the average displacement distance of freely migrating interstitials is derived. The increase of this distance with decreasing energy is explained by a simple model that uses two displacement mechanisms differing in the specific energy losses. (auth)

8774 DISORDERING OF AN ALLOY BY ELECTRON IRRADIATION IN A 1.2-MV ELECTRON MICROSCOPE. Cordier, A.; Degeilh, A.; Garat, F.; Reynaud, F. (CNRS, Toulouse). Radiat. Eff.; 17: No. 1-2, 127-132(Jan 1973). (In French).

The bombardment of an ordered Ni_3Mn crystal by the beam electrons of a 1.2-MV electron microscope leaves this alloy in a partially disordered state. The degree of order thus obtained depends on the direction of irradiation. A method is given for calculating the degree of order for any direction of irradiation; this method, using the stereographic projection, takes into account the focusing of the collisions along the <110> atomic rows. (auth)

8775 EFFECTS OF ROOM-TEMPERATURE PROTON RADIATION DAMAGE ON THE CONDUCTANCE OF REACTIVELY SPUTTERED TANTALUM THIN-FILM RESISTORS FOR FLUENCES UP TO 2×10^{18} p/cm^2. Hardy, W. R.; Schewchun, J. (McMaster Univ., Hamilton, Ont.). Radiat. Eff.; 17: No. 1-2, 119-125(Jan 1973).

Tantalum thin-film resistors reactively sputtered in oxygen and nitrogen simultaneously were irradiated by 150-keV protons at 286°K. For discontinuous films consisting of metallic islands largely surrounded by Ta_2O_5, the conductance initially increases with fluence until a dopant-dependent threshold fluence is reached, at which point the conductance decreases rapidly with fluence. The conductance increase is attributed to an enhanced tunneling current resulting from radiation-produced defects within the inter-island oxide regions. The nonlinearity in this conductance increase is ascribed to mobile defects annihilating at the gap-island interfaces during irradiation. The subsequent conductance decrease may be accounted for by an increase in the inter-island tunneling barrier as a result of unequal concentrations of donor and acceptor defects annihilating at gap-island interfaces, thus producing a radiation-produced shift in the Fermi level. In contrast to this behavior, the conductance of continuous polycrystalline films of Ta_2O_5 increases with fluence and approaches apparent saturation. This nonlinearity is attributed to unstable defect production due to a combination of spontaneous recombination and close-pair thermal annealing. The lack of a radiation-produced conductance decrease can be accounted for by the absence of gap-island interfaces. (auth)

8776 EFFECT OF OXYGEN ON DISLOCATION CHANNELING IN NEUTRON-IRRADIATED VANADIUM. Huang, Y.; Arsenault, R. J. (Univ. of Maryland, College Park). Radiat. Eff.; 17: No. 1-2, 3-11(Jan 1973).

The phenomenon of "dislocation channeling" has been observed in many metals. However, there have not been any systematic investigations of the effect of an impurity interstitial on channeling. The purpose of this investigation was to study the effect of oxygen on the channeling in neutron-irradiated and deformed single crystals of vanadium. One of the main observations was the appearance of dislocation tangles and arrays within the channels independent of oxygen concentration. The probability of observing dislocation arrays and density of dislocations within the channels increased with increasing oxygen concentration. However, the dislocations within the channels are probably remnants of a widening process, for the density of dislocations within the channels increased with increasing foil thickness. A mechanism is proposed for channel widening that would predict dislocation remnants within the channels. (auth)

8777 DISLOCATION LINE KINETICS AS AFFECTED BY HIGH-TEMPERATURE PULSE IRRADIATIONS. Simpson, H. M.; Sosin, A.; Johnson, D. F. (University of Utah, Salt Lake City, Utah 84112). J. Appl. Phys. 44: No. 4, 1435-1440 (Apr 1973).

Pulse experiments are described in which a pure copper sample was bombarded for 20 sec with 1-MeV electrons at temperatures between 293 and 430 °K, then the continuing increase in accumulation of point defects at dislocations was monitored at temperature by internal friction and elastic modulus data. No discontinuity in the rate of arrival is found at the moment that the irradiation is discontinued, indicating that the arriving point defect must be characterized in its motion by an energy of 0.6 eV. The postirradiation kinetics are analyzed to show that the energy of migration of this defect along dislocations is ≈0.2 eV less than the energy for motion in the lattice, away from the dislocations. The above kinetic analyses are carried out with the aid of the recently formulated "defect dragging" theory of Simpson and Sosin and constitute further verification of this theory. (auth)

8778 PARAMAGNETIC CENTERS IN γ-IRRADIATED ALUMINUM OXIDE. Shirikov, N. G.; Anufrienko, V. F.; Sazonov, L. A. (Inst. of Catalysis, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 208: No. 4, 902-905(1 Feb 1973). (In Russian).

The nature of paramagnetic centers in irradiated γ-Al_2O_3 and their reaction tendency toward O_2, H_2, and CO_2 were elucidated. The Al_2O_3 was prepared by calcining $Al(OH)_3$ at 700°C, and then the oxide was irradiated with ^{60}Co gamma rays at 40°C. EPF spectra were obtained from the irradiated Al_2O_3 that had been subjected to vacuum or various gaseous atmospheres. (KSW)

8779 INFLUENCE OF ANGULAR DIVERGENCE OF A BEAM ON THE LUMINESCENT YIELD INCREASE IN A SINGLE CRYSTAL OF CsI(Tl) IN ALPHA-PARTICLE CHANNELING. Shipatov, E. T. (Donetsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 3, 139-140(1973). (In Russian).

A previous study was made by the author of the increase in yield in luminescence of a CsI(Tl) crystal when exposed to 5.49-MeV alpha particles, for different angles of incidence of the beam to the crystallographic axes. This study was extended here to the change in angular dependence of the light yield with increase in the angular divergence of the alpha-particle beam that bombarded the CsI(Tl) crystal. Such changes were particularly evident when the alpha-particles channeled through the crystal. (KSW)

Other Materials

Refer also to abstracts 7949, 7991, 7995, 8564, 8607, 8611, 8620, 8621, 8633, 8672, 8676, 8745, 8746, 8762, 10029, 10062, 10083, 10086, 10101, and 10477.

8780 (BDX-613-860) BONDING DEGRADATION IN THE TANTALUM NITRIDE–CHROMIUM–GOLD METALLIZATION SYSTEM. Panousis, N. T.; Bonham, H. B. (Bendix Corp., Kansas City MO.). Apr 1973. Contract AT(29-1)-613. 20p. (CONF-730420-1). Dep. NTIS $3.00.

From Reliability physics symposium; Las Vegas, Nevada, USA (3 Apr 1973).

Thermocompression bondability in the tantalum nitride–chromium– gold metallization system is degraded because of diffusion and oxidation of chromium resulting from a 300°C two-hour air bake used to stabilize the tantalum nitride resistor network. Bondability can be restored by chemically removing the contaminant with either a gold (potassium iodide and iodine) or a chromium oxide (ceric ammonium nitrate) etch treatment before thermocompression bonding. The integrity of bonds made to restored films is not degraded in tests at temperatures between –50 and 350°C for up to 200 hours. Delamination at the gold/chromium interface could not be induced by extended etching in ceric ammonium nitrate for as long as 96 hours. (auth)

8781 (DP-Report-657) DIMENSIONAL AND PHYSICAL PROPERTY CHANGES OF HIGH-TEMPERATURE REACTOR GRAPHITES IRRADIATED AT TEMPERATURES IN THE RANGE 600 to 1200°C. Dragon Project. Everett, M. R.; Blackstone, R.; Graham, L. W.; Manzel, R. (Atomic Energy Establishment, Winfrith (England)). Aug 1969. 35p. (CONF-690627-4). Dep. NTIS (U. S. Sales Only) $3.75.

From 9th conference on carbon; Boston, Massachusetts, USA (16 Jun 1969).

Results of irradiation testing of coated particles of UO_2 and UC incorporated in resin-bonded matrices are presented. Emphasis is placed on dimensional and physical property changes in these materials in the core of high-temperature reactors. Particle coatings used in the study include pyrolytic carbon and SiC. (JRD)

8782 (EUR-4947) EFFECT OF MACROPOROSITY DISTRIBUTION IN INDUSTRIAL ELECTROGRAPHITES ON MECHANICAL RESISTANCE. Lanza, F.; Marengo, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 18p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.00. EUR.BF.40.-.

The distribution of macroporosity of three industrial graphites is analyzed following a log-normal model. The parameters of the distribution are obtained as a function of the density of the sample. The probability of encountering pores with such a dimension to cause a fracture following a Griffith model is calculated. These values are compared with the experimental values. As far as the studied graphite is concerned, such a mechanism does not seem to be present significantly. (auth)

8783 (EUR-4951) MIGRATION OF FISSION PRODUCTS IN NEAR-ISOTROPIC PYROCARBON. Final Report. Chinaglia, B.; Mosca, G.; Walther, H. (Societa Ricerche Impianti Nucleari, Saluggia (Italy)). May 1973. 56p. Dep. NTIS (U.S. Sales Only) $5.00. EUR B.Fr. 70.-.

The migration of Ba, Xe, Zr, and Cs atoms in pyrocarbon was measured in the range of temperature between 1200 and 1800°C. The pyrocarbon samples were of different types and origin and were characterized by x ray analysis. Rather large variations of apparent diffusion constants have been measured for the examined fission products among the various pyrocarbon types. No definite correlation has been found between the diffusion constants and the structural parameters. It is suggested that revised diffusion models and improved microstructural characterization are needed for a better description of the atomic transport in pyrocarbon. (auth)

8784 (FRNC-TH-320) STUDY OF PARAMAGNETIC DEFECTS FORMED BY IRRADIATING A Y-TYPE ZEOLITE WITH γ RADIATION. Abou Kais, A. (Lyon Univ. (France)). 1972. 132p. (In French). Dep. NTIS (U.S. Sales Only) $8.75.

Thesis.

The ESR spectra of zeolites ($NaNH_4Y$ and NaHY) calcinated (in vacuo) at different temperatures and then irradiated at 77°K with a 2.4-Mrad dose of radiation were studied. These spectra are in the form of a doublet due to atomic hydrogen superimposed on a complex central signal due to various paramagnetic defects. Studies of these spectra indicate that four types of trapping site exist for hydrogen in these zeolites. One of these sites is dominant for calcination temperatures of less than 150°C and is characterized by a line having a width of 3.15 Gs; this line is associated with the presence of ammonium ions in the solid. The remaining three sites are characterized by lines having widths of 1.25, 3.6 (observed at calcination temperatures of between 150 and 500°C), and 0.9 Gs (observed at temperatures of above 500°C), respectively. These sites are associated with the presence of the most acidic OH groups in the solid. It was shown that only most acidic OH groups (measured by the number of trapped H^0) are catalytically active. It was also shown that the form of the line corresponding to atomic hydrogen is lorentzian and that the H^0 signal is appreciable under microwave saturation conditions. The paramagnetic defects produced in these zeolites by irradiation at 77°K were identified. Three types of signal are distinguished in the complex central signal: a highly anisotropic signal obtained after treatment under vacuum at room temperatures; an asymmetric signal exhibiting a 6-line structure obtained after calcination between 150 and 500°C; a signal exhibiting 12 equidistant lines obtained after calcination at temperatures of above 500°C. The chemical reactivity of these defects in relation to certain compounds (H_2, O_2, CO, and CO_2) was then studied. (France)

8785 (LA-5223-PR) CMB-13 RESEARCH ON CARBON AND GRAPHITE. Report No. 22: Summary of Progress, May 1–July 31, 1972. Smith, M. C. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 21p. Dep. NTIS $3.25.

Results of ablation tests in the "sublimation regime" of temperatures, above about 3500°K, indicated only relatively small differences in mass-loss rate among a wide variety of LASL experimental graphites. However, correlation of these differences with raw-materials characteristics, manufacturing procedures, and microstructures before and after testing has provided useful clues to both ablation mechanisms and means of improving ablation resistance at very high temperatures. In an investigation of coal-tar and petroleum-pitch binders, it was found that in general the higher the quinoline-insoluble content of the pitch the greater its coking value and the smaller the crystallite size of its graphitized carbon residue. Results are reported for the use of experimental phenolic binders, organometallic additions to both resin and pitch binders, and impregnation experiments using both resin and pitch impregnants. In an extension of particle-packing theory, it was found necessary to separate "triangular" distributions into three general families according to their skewness. (auth)

8786 (SC-B-710148(Suppl.1)) ION IMPLANTATION: A SELECTIVE BIBLIOGRAPHY. Seager, D. K. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 87p. Dep. NTIS $3.00.

This bibliography of titles and abstracts covers the research on ion implantation from October 1970 through December 1972. It supplements SC-B-71 0148 which includes references from January 1967 through September 1970. (206 references) (auth)

8787 ALKALI RESISTANCE OF AIR-FILTER MEDIA FOR OFF-GAS SYSTEMS OF FAST REACTOR. Kitani, S. (Japan Atomic Energy Research Inst., Tokai); Uno, S.; Takahashi, K. Kuki Seijo; 10: No. 2, 37-40(Jun 1972). (In Japanese).

Alkali resistance of several kinds of air-filter media, composed of fibers of acryl, nylon, polyester, polypropylene, carbon, stainless steel and glass, respectively, was tested. Mechanical strength of these mediums was measured after they were dipped in the aqueous solution of 40% NaOH. Efficiency of aerosol collection and capacity for dust preservation of the media were measured. Effect of alkali adhesion on the efficiency of DOP aerosol collection and pressure drop in high efficiency air filters were investigated. It is found that the mediums composed of polypropylene, carbon, and stainless steel fibers have excellent performance. (JA)

8788 PROCESS FOR EXTRACTION OF A MONOCRYSTAL OF A SEMICONDUCTING COMPOUND FROM A FUSED MASS BY MEANS OF A VOLATILE COMPOUND. Grabmaier, J. (to Siemens AG). German Patent 1,954,957. 6 May 1971. Filed date 21 Oct 1969. (In German).

A procedure is described in which a quantity of a semiconducting compound is melted at the same time as a quantity of B_2O_3 in a crucible in inert material in such a way that a protective layer of molten B_2O_3 covers the fused mass of the semiconducting compound. Then a monocrystalline nucleus of the semiconducting material in question is placed in contact through the molten B_2O_3 with the fused semiconducting material, and the monocrystal is extracted by gradual withdrawal of the nucleus crystal. It is characterized by the fact that an ampoule made of inert material filled with anhydrous B_2O_3 is closed and heated with the molten semiconducting material in the fusion crucible and that B_2O_3 is added to the fused mass, whereupon the ampoule cracks by cooling of the B_2O_3, and finally the preparation is heated anew until a fused mass, covered with melted B_2O_3, of the semiconducting material is produced. (TSS)

8789 EFFECT OF γ RADIATION ON PAINT FILMS. Shigofin, V. G.; Egorov, B. N. Continental Paint Resin News; 9: No. 8, 7-8(1971).

The radiation resistance of a water resistant epoxy/pitch enamel SP-EK-4 and a chlorosulfonated polyethylene enamel SP-KhSPE-5 has been investigated and the effect on other paint film parameters has been evaluated. The results are correlated graphically and the mechanism and nature of γ-radiation activity are discussed. (Corros. Abstr.)

8790 IMPROVEMENTS IN AND RELATING TO METHODS OF MANUFACTURING SEMICONDUCTOR DEVICES. Shannon, J. M. (to Mullard Ltd.). British Patent 1,307,546. 21 Feb 1973. Filed date 22 May 1970. 19p.

A method of manufacturing a semiconductor device is described, wherein a semiconductor body comprising a division between a higher doped region and a lower doped region is subjected to bombardment with a beam of energetic particles from the lower doped side, the bombardment causing damage of the crystal structure in the vicinity of the dividing boundary. The semiconductor body is maintained at an elevated temperature during the bombardment so as to enhance impurity diffusion across the dividing boundary from the higher doped region into areas of the lower doped region affected by the radiation damage. The bombardment may be conducted with protons, neutrons, or impurity ions, and the incidence of the bombarding particles on the semiconductor body may be such as to produce channeling of the crystal lattice. The doped region may be of the same or different conductivity types, and the dividing boundary may substantially coincide with the interface between a substrate and an epitaxial layer thereon, with the higher doped region in the substrate and the lower doped region in the epitaxial layer. Masking may be employed. The method may be employed to manufacture planar bipolar and other types of transistors. (UK)

8791 ACCUMULATION OF F_1 AND F_2 CENTERS IN NaF CRYSTALS UNDER BOMBARDMENT PROTON. Vaisburd, D. I.; Umetov, E. U. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 138-139(1973). (In Russian).

Single crystals of NaF were irradiated with 4.7-MeV protons and the resulting concentrations of F_1 and F_2 centers were determined from optical absorption spectra. The F_1 center accumulation curve showed a very fast, followed by a very slow rise, attaining a center concentration of $>10^{18}$ cm^{-3}. A study was made of the ratio of F_2 concentration/F_1 concentration as a function of proton dose. (KSW)

8792 SLIPFORM CONSTRUCTION OF CONCRETE NUCLEAR SHIELD WALLS. Ellison, J. C. (Fegles-Power Service Corp., Minneapolis). J. Amer. Concr. Inst.; 70: No. 3, 178-181(Mar 1973).

For nuclear projects that have multibarrier containment that incorporates concrete shield walls, this method of construction has proved to have definite advantages in time and cost. In the scheduling for the jobs done to date, the concrete shield walls have been constructed before the steel vessel, mainly because of the short time necessary to construct the wall after the mat has been completed, plus its added use and protection for erection of the

steel vessel. However, if there is an advantage to erecting the steel vessel first, the concrete wall can be slipped after the vessel is up. (auth)

8793 RANGE PROFILES. Whitton, J. L. (Chalk River Nuclear Labs., Ont.). pp 253-281 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

Of the seven parameters listed, those of crystal orientation, incident ion energy, incident ion type, and target type affect the depth to which incoming particles penetrate, while the remaining three, target temperature, crystal disorder, and bombardment dose affect mainly the number of incoming particles reaching that penetration depth (the dechanneling rate). The inability to accurately predict the dechanneling rate is the reason that only the trend may be predicted and this is due to the fact that almost all profiles are influenced along the entire range by the two processes of nuclear and electronic stopping. Where only low-energy implants into amorphous materials are considered, the profile may be readily forecast by application of current theory. In a similar way, for properly channeled particles slowed by electronic stopping, the measurement of R_{max} of one incident ion, at one energy into one target material, allows extrapolation of R_{max} to higher and lower energies by use of the $R_{max} \cdot E^{0.5}$ relationship. (15 figures, 45 references) (DLC)

8794 POSTLUMINESCENCE OF CaF_2:NdF_3 CRYSTALS IRRADIATED BY γ RAYS FROM ^{60}Co. Tavshunskii, G. A.; Kaipov, B. (Inst. of Nuclear Research, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 82-84(1973). (In Russian).

Postluminescence was investigated in crystals of CaF_2 activated with 0.1 and 0.8 wt % NdF_3, following γ-irradiation of the crystals at 77 and ~300°K. Interpretation of the results was in terms of movement of nodal holes and their recombination with Nd^{2+}. Similar results were obtained by substituting Pr or Tb for Nd. (KSW)

8795 DRAWING OF FIBERS FROM IRRADIATED POLYETHYLENE SINGLE CRYSTALS. Peterman, J.; Gleiter, H. (Ruhr Univ., Bochum, Ger.). J. Polym. Sci., Polym. Phys. Ed.; 11: No. 2, 359-368(Feb 1973).

The relationship between the structural defects present in crystalline polymers and the molecular structure of the drawn material is studied by drawing fibers from irradiated polyethylene single crystals. Irradiation introduces a structural defect in the crystal lattice since it generates crosslinks preferentially, the density of which is controlled by the radiation dose. Observations by means of transmission electron microscopy and electron diffraction indicate that fiber drawing occurs by breaking off of single blocks of folded chains and by subsequent thermally activated rearrangement of the molecules in the drawn material. With increasing crosslink density the size of the blocks decreases, and the fibers become increasingly interconnected so that a network of fibers is formed. If the dose is about 10 Mrad, the crosslinks present in the crystals result in the formation of bundles of fibers. Above 35 Mrad the formation of fibers (single fibers as well as bundles) ceases, and the drawn material forms a thin (15 Å), continuous film. The observed change in morphology with increasing dose (crosslink density) is interpreted in terms of the additional bonding forces between adjacent chains due to crosslinks. (auth)

8796 THERMAL AND ELECTRICAL CONDUCTIVITIES OF SILICIFIED GRAPHITES. Lutkov, A. I.; Volga, V. I.; Dymov, B. K.; Mikhailov, V. N.; Tarabanov, A. S.; Bobkovskii, V. N. High Temp. (USSR) (Engl. Transl.); 10: No. 5, 901-904(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 1002-1006 (1972).

The results of measurements of the thermal and electrical conductivities of pure and silicified graphites, obtained in the 80 to 2500°K range, are reported and discussed. It is shown that in the case of such a multiphase material as silicified graphite the thermal and electrical conductivities are determined by the graphite framework, by free silicon, and by silicon carbide. Therefore, the thermal conductivity and the electrical resistivity of silicified graphites are higher than the corresponding properties of the original materials. (auth)

8797 ENTHALPY AND SPECIFIC HEAT OF GRAPHITE IN TEMPERATURE RANGE 273 TO 3650°K. Sheindlin, A. E.; Belevich, I. S.; Kozhevnikov, I. G. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 5, 897-900 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 5, 997-1001 (1972).

The results are given of an investigation of the high-temperature enthalpy and specific heat of various Soviet brands of graphite. Equations are suggested for the temperature dependences of these properties. The error in the measurements of the enthalpy is estimated to be ±2.3%. Tables of the principal thermal properties of graphite are given. (auth)

8798 THERMAL CONDUCTIVITY OF NEUTRON-IRRADIATED GRAPHITES BETWEEN 80 AND 1000°C. Binkele, L. (Kernforschungsanlage, Juelich, Ger.). High Temp.–High Pressures; 4: No. 4, 401-409(1972).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

Knowledge of the thermal conductivity of reactor graphite in relation to graphite structure, temperature, and the damaging effect of fast neutrons is of great importance for reactor design. A method is described that permits rapid out-of-pile measurements on small specimens of neutron-irradiated graphite at temperatures between 80 and 1000°C. The method has proved its value in numerous measurements of the thermal conductivity of irradiated graphite specimens. Typical measurements are presented for various irradiation temperatures between 400 and 1350°C and various values of fast neutron fluence. Neutron irradiation was found to affect both the absolute value and the temperature dependence of thermal conductivity. The measured temperature dependence is interpreted on the basis of an earlier hypothesis and the resulting discrepancies are indicated. (auth)

8799 EPOXY AND VINYL ESTER RESINS IN DUTCH NUCLEAR POWER STATION. Reinf. Plast. (London); 17: No. 2, 48-49(Feb 1973).

It is stated that epoxy resins are being used as coatings for walls, floors and other parts of the reactor under construction at Borssele in the Netherlands and also as a newly developed mortar for use with heavy water pumps. The resins give improved radiation resistance as well as maintaining a dust-free condition and facilitating decontamination. Epoxy resin surfactant compounds also replace bitumen in the power station roof. Physical properties of the resin are stated, particularly in relation to concrete. (UK)

8800 SURFACE TRACKS (S-TRACK) FROM AN EXTERNAL SOURCE OF FISSIONING NUCLEI ON CRYSTALS OF MUSCOVITE, LITHIUM FLUORIDE, AND GYPSUM. Geguzin, Ya. E.; Vorob'eva, I. V. (Kharkov State Univ.). Dokl. Akad. Nauk SSSR; 208: No. 3, 584-586(21 Jan 1973). (In Russian).

The surface defect caused by the impact of a fission fragment on the surface of a crystal is called a surface track (S track). This paper is confined to surface tracks caused by a source from outside the crystal. The types of crystals used in these experiments were KCl, NaCl, KBr, $CaCO_3$, LiF, topaz, mica, gypsum, and $Al_2(SO_4)(F,OH)_2$. A natural cleavage surface of the crystal was exposed to fragments from ^{252}Cf, and the S tracks formed were observed with an electron microscope. A typical S track has three clearly observable sections, the result of different fragment/crystal interactions; these phenomena are discussed. (KSW)

8801 GETTER-SPUTTERING APPARATUS AND METHOD. James, D. W. F.; Coltman, H. D.; Spiller, D. O. (to University Coll. of North Wales). British Patent 1,301,653. 4 Jan 1973. 5p.

Apparatus is described for depositing thin films of conductors and/or insulating materials for thin-film and integrated circuits, and the like, using materials hitherto difficult to use or in purities hitherto difficult to obtain. A getter chamber is incorporated in the sputtering chamber and the only means of access of gas to the latter is through the getter chamber by way of a narrow passage formed by the dividing wall between the two chambers. The sputtering chamber may be cylindrical, with an annular getter chamber, and the means for mounting the substrate may comprise a slide support inserted or removed through an aperture in the apparatus housing, with a gas-tight seal between the mounting support and the aperture. The sputter and getter electrodes may be energized from an rf ac source. (UK)

8802 DESIGN PHILOSOPHY FOR BORON/EPOXY STRUCTURES. Hadcock, R. N. (Grumman Aerospace Corp., Bethpage, NY). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 28-40(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

The philosophy followed to satisfy design requirements for aircraft structures is discussed. An approach is described which has been successfully used to generate boron/epoxy design allowables data on the basis of 90% probability of survival with a confidence of 95%. This approach results in design strength data which include not only the variations in material properties but also any inadequacies in theoretical methods for strength prediction. Results of tests on full-scale components and subcomponents are

compared with theoretical predictions using these design allowables data. (auth)

8803 THERMAL EXPANSION CHARACTERISTICS OF GRAPHITE-REINFORCED COMPOSITE MATERIALS. Freeman, W. T. (Hercules Inc., Cumberland, MD); Campbell, M. D. ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 121-142 (1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

An investigation to determine the thermal-expansion characteristics of graphite composites is described. Thermal-strain measurements over a wide temperature range, −320 to 550°F, were made using a modified Leitz dilatometer. Measurements of the longitudinal and transverse dilatation of five composite systems containing high-modulus and high-tensile-strength graphite fibers in three different resin binders are reported. Moisture content was found to have a significant effect on thermal strain vs temperature hysteresis characteristics of both neat resins and composites. Moisture removal at high temperature was manifested as a shrinkage in the material length, and the thermal expansion coefficient remained constant over a given temperature range after sufficient drying. With the exception of unidirectional composites, the thermal coefficient increased nonlinearly with temperature. (auth)

8804 INFLUENCE OF LOCAL FAILURE MODES ON THE COMPRESSIVE STRENGTH OF BORON/EPOXY COMPOSITES. Suarez, J. A.; Whiteside, J. B.; Hadcock, R. N. (Grumman Aerospace Corp., Bethpage, NY). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 237-256(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

The compressive strengths of boron/epoxy laminates are developed theoretically and verified by tests on coupons, honeycomb sandwich columns, and honeycomb sandwich beams. Filament fracture occurs at high stress levels but laminate strengths are limited by overall and local instability. The effects of normal (interlaminar) shear stiffness on laminate stability are found to be significant. Layer instability, sandwich face wrinkling, and sandwich face dimpling are investigated. Associated with sandwich face wrinkling are laminate local instability, separation from core (bond tensile failure or honeycomb core tensile failure), core crushing, and core shear failure. Consistent assumptions of initial laminate waviness provide good correlation between analyses and tests. (auth)

8805 EMBEDDED STRAIN GAGE TECHNIQUE FOR TESTING BORON/EPOXY COMPOSITES. Daniel, I. M. (Illinois Inst. of Tech., Chicago); Mullineaux, J. L.; Ahimaz, F. J.; Liber, T. ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 257-272(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

An embedded strain gage technique for measuring subsurface strains in boron/epoxy composites was developed and tested. Preliminary tests to establish the feasibility of the technique demonstrated that conventional foil gages do not produce local thickening of the specimen when a patch of scrim cloth is removed, do not change the average material properties, and do not reduce the strength of the specimen. The technique was used to determine surface and subsurface strains in three-, five-, and seven-ply boron/epoxy tension coupons of three different layups. Results are presented first in the form of stress-strain curves for each ply and then as strain variations through the thickness with applied stress as a parameter. Values of modulus, Poisson's ratio, and strength were obtained from these tests. Deviations of varying degrees were observed in the strain readings through the thickness. The diagonal (45°) strain deviations were higher than those of the transverse strains, which in turn were higher than those of the longitudinal strains. It was also observed that deviations tended to be smaller when the gages were oriented in the direction of the fibers than when they were oriented transverse to them. (auth)

8806 TOUGHNESS OF FILAMENTARY BORON/ALUMINUM COMPOSITES. Hancock, J. R.; Swanson, G. D. (Midwest Research Inst., Kansas City, MO). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 299-310(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

An exploratory study was carried out to determine whether, in terms of the definitions and test procedures developed for alloys, valid fracture toughness values could be measured for highly anisotropic and heterogeneous boron/aluminum composites. The mechanical-test results were correlated with acoustic emissions from filament breakage, with fractography, and with high-speed movies of surface deformation and crack growth. The results indicate that conventional concepts of fracture toughness can be applied to filament-reinforced metals to provide engineering-design data. (auth)

8807 IMPACT BEHAVIOR OF UNIDIRECTIONAL RESIN MATRIX COMPOSITES TESTED IN THE FIBER DIRECTION. Novak, R. C.; DeCrescente, M. A. (United Aircraft Research Labs., East Hartford, CT). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 311-323(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

Charpy impact strength data are presented for unidirectional graphite/, boron/, and glass/resin composites tested in the fiber direction. The impact strength of glass/resin is significantly higher than that of either the boron or the graphite composites. The mechanisms by which resin matrix composites absorb energy are studied, and it is found that the tensile stress-strain characteristics of the fibers are of primary importance in determining the level of composite impact resistance. The toughness of the resin matrix is shown to represent a small contribution to composite impact energy. Increasing the impact strength of boron and graphite composites by the inclusion of glass fibers is discussed. (auth)

8808 STRESS CONCENTRATIONS AND FAILURE CRITERIA FOR ORTHOTROPIC AND ANISOTROPIC PLATES WITH CIRCULAR OPENINGS. Greszczuk, L. B. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 363-381(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

Theoretical solutions and results are given for stress concentrations and failure stresses in orthotropic and anisotropic composite plates. Solutions for the stresses around the opening are given for plates subjected to uniaxial, biaxial, and shear loading. The types of composites for which equations are given for stress concentration factors include unidirectional laminates, unidirectional laminates with oriented fibers, bidirectional balanced laminates and multilayered laminates. A failure criterion based on modified Hencky−von Mises distortion energy theory is also presented for predicting (1) the externally applied load which will initiate failure at the opening and (2) the location of the failure. The strength of composite plates with cutouts is less sensitive to stress concentrations than the strength of plates made of isotropic materials. (auth)

8809 REINFORCED CUTOUTS IN GRAPHITE COMPOSITE STRUCTURES. Kocher, L. H.; Cross, S. L. (Bell Aerospace Co., Buffalo). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 382-395(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

A 1-in.-diameter, unreinforced hole in a 6-in.-wide, multidirectional, graphite composite laminate test specimen is shown to reduce the gross section strength by a factor of two. This stress and strain concentration effect is more severe than with most metals because of the nonyielding behavior of the composite, but is not as severe as with typical brittle materials. Integral composite reinforcements around holes in several tension specimens are shown to carry loads efficiently, that is, they develop 80 to 90% of the strength of a specimen without a hole. For the particular metallic and composite reinforcement designs considered, the composite reinforcements are three to six times as light as metallic ones, giving approximately the same load carrying capability. Although these reinforcements are not of an optimum configuration, they demonstrate a capability for reinforcing cutouts in composite structures. (auth)

8810 STRENGTH OF BOLTED CONNECTIONS IN GRAPHITE/EPOXY COMPOSITES REINFORCED BY COLAMINATED BORON FILM. Padawer, G. E. (National Research Corp., Cambridge, MA). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 396-414(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

Unidirectional (all 0°) bidirectional (±45°), and tridirectional (0°, ±45°) graphite fiber/epoxy resin composites were fabricated to form a series of double-lap-bolted joint models. These models were tested to measure the joint strength effectiveness of trans-

versely isotropic boron film colaminated locally at 6 and 12 vol % levels. Results show that the addition of film plies to the highly directional fiber laminae increases the joint strength and stiffness up to 200%, the chief contribution of the boron film being high bearing strength and resistance to shear distortion. A novel test method for bolted lap joints was developed in which the bolt head pressure was maintained constant by means of preloaded springs, thus eliminating the ambiguity resulting from an inconstant contribution of the bolt clamping friction to the total joint strength. The strength weight effectiveness of boron film reinforcement in this particular application is demonstrated. (auth)

8811 VIBRATION CHARACTERISTICS OF UNIDIRECTIONAL FILAMENTARY COMPOSITE MATERIAL PANELS. Clary, R. R. (Langley Research Center, Hampton, VA). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 415-438(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

An experimental and analytical study of the vibration characteristics of a series of boron/epoxy composite panels with all layers having the same filament orientation was conducted. Nodal patterns and natural frequencies are found to be highly dependent on the filament angle. Frequencies change by as much as 90% with a 30° change in the filament angle. Measured damping coefficients are only moderately higher than those of comparative aluminum panels. There is no strong correlation between the filament angle and the amount of damping. In general, calculations based on a finite element mathematical model are in good agreement with the experimental data. (auth)

8812 ANALYSIS OF AN IMPROVED BORON/ALUMINUM COMPOSITE. Jones, R. C. (Massachusetts Inst. of Tech., Cambridge); Christian, J. L. ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 439-468(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

Improvements in the mechanical properties of a boron/aluminum composite material have been achieved through thermal treatments and the addition of small amounts of high-strength stainless steel wires perpendicular to the boron. This study provides an analysis of these improved composite materials, utilizing scanning electron microscopy and x-ray radiography to examine the micromechanics of the composites and their fiber and matrix components. Phenomena analyzed and discussed are matrix–matrix bonding, filament–matrix bonding, matrix failure, filament damage, and fracture initiation and propagation. (auth)

8813 TRANSVERSE STRENGTH OF BORON FIBERS. Kreider, K. G.; Prewo, K. M. (United Aircraft Research Labs., East Hartford, CT). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 539-550(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

A fiber crushing test which relates to previous testing procedures for brittle materials was developed. The test is used to determine the tensile strengths of fibers, particularly with respect to the propagation of pre-existing flaws. The transverse strength of 4-mil (0.010-cm)-diameter boron and Borsic fibers was surprisingly low (30,000 psi) indicating severe anisotropy. This strength anisotropy was related to the residual stress pattern retained from manufacture and pre-existent flaws in the fiber. Boron and Borsic fibers 5.6 mil in diameter did not suffer such severe strength anisotropy and demonstrated excellent transverse strength properties in the fiber crushing test. Both observations are confirmed in tests of metal–matrix composites. (auth)

8814 EVALUATION OF UNIDIRECTIONAL GLASS– GRAPHITE FIBER/EPOXY RESIN COMPOSITES. Kalnin, I. L. (Celanese Research Co., Summit, NJ). ASTM (Amer. Soc. Test. Mater.) Spec. Tech. Publ.; No. 497, 551-563(1972).

From 2nd conference on composite materials: testing and design; Anaheim, California, USA (20 Apr 1971).

See ASTM-STP-497; CONF-710403-.

Evaluation of fiberglass–graphite performance of unidirectional epoxy laminates containing different relative amounts of each reinforcement. As an all-fiberglass reinforcement is progressively replaced by graphite fiber, the longitudinal composite fracture stress and strain decrease rapidly for all loading modes except shear, accompanied by a substantial increase in the tensile and compressive stiffness. Conversely, upon introducing some fiberglass into a graphite composite, its strength declines in proportion to the decrease in graphite fiber content. The maximum torsional shear stress is approximately 8 ksi for all combinations of glass and graphite. Most of the transverse mechanical properties decrease linearly upon progressive replacement of the fiberglass by graphite. The transverse torsional shear properties are about 20% lower than the longitudinal ones. The magnitude of the flexural modulus, which depends not only on the graphite content but even more so on the distance of the graphitic plies from the center plane of the laminate, may be calculated by means of the existing theory of bidirectional laminates. It is concluded that the large increase in composite stiffness upon addition of a small amount of oriented graphite fiber is the most salient characteristic of glass–graphite hybridization. (auth)

8815 INFLUENCE OF GRAPHITE CORROSION ON GAS DIFFUSION IN REACTOR GRAPHITE. Hugo, P. (Univ., Hamburg). pp 75-95 of Festigkeits- und Diffusionsprobleme von Hochtemperatur-Reaktor-Werkstoffen. Melkonian, G. A. (ed.). Munich; Verlag Karl Thiemig KG (1972). (In German)

From Radiation effects on materials; Hamburg, F. R. Germany (22 Oct 1971). See CONF-711074-.

The change in the pore structure of reactor graphite was studied during burnup. In homogeneous graphite, the experimental results could be interpreted through simple theoretical considerations. In graphite that was not homogeneous, the rate of burnup was not uniform, and a simple interpretation was impossible. Gas diffusion through the pores of graphite was studied on samples with various degrees of burnup. Samples with uniform pore radius allowed easy evaluation and theoretical interpretation. With increasing burnup, the pore structure generally became less uniform and the measured data could be interpreted only approximately. (HBG)

8816 TRUDY SIMPOZIUMA PO FIZIKE PLASMY I ELEKTRICHESKIM NEUSTOICHIVOSTYAM V TVERDYKH TELAKH, VILNYUS, 10–12 IYUNYA 1971 g. (Proceedings of the Symposium on Plasma Physics and Electrical Instabilities in Solids, Vilnyus, USSR, June 10–12, 1971). Pozhela, Yu. (ed.). Vilnyus, USSR; Izdatel'stvo Mintis (1972). 288p. (CONF-710661-).

From Symposium on plasma physics and electrical instabilities in solids; Vilnius, USSR (10 Jun 1971).

Fifty-one papers were presented, detailing the results of theoretical and experimental studies in the following areas: hot current carriers, electrical instabilities, and solid-state plasma. The papers are broadly categorized as follows: general questions (8 papers); plasma (5 papers); recombination of hot electrons (6 papers); hot electrons in Ge and Si (14 papers); hot electrons and instabilities in InSb and other semiconductors (10 papers); Gunn Effect (5 papers); and different questions (3 papers). (LMT)

8817 METHOD FOR THE TREATMENT OF SILICON TRANSISTORS WITH SILICON DIOXIDE SURFACE LAYERS. Baeuerlein, R.; Uhl, D. (to Siemens AG). German Patent 1,904,763. 15 Mar 1973. Filed date 24 Sep 1970. 5p. (In German).

A method is described for the treatment of silicon transistors with silicon dioxide surface layers in which the transistor is exposed to x-ray, γ, or electron irradiation so high that the silicon dioxide layer is penetrated by at least part of the irradiation. The transistor was subjected to a repeated sequence of irradiation and electrical charging of the p-n transition without radiation effect. The radiation dose used is in the range of 10^4 to 10^9 rad. Because of the electrical charge, a boundary effect occurs between 50 and 250°C. The electrical charging was carried out so that the boundary effect occurred between 80 and 160°C. The electrical charging of a silicon planar transistor takes place in such a way that the emitter-base transition is poled in the transmission direction. An additional electrical voltage is imposed between the emitter and collector contacts or between the base and collector contacts. The collector–base transition of the silicon transistor is charged in the boundary direction. (JSR)

8818 PROFILES OF BORON IMPLANTATIONS IN SILICON MEASURED BY SECONDARY-ION MASS SPECTROMETRY. Hofker, W. K.; Werner, H. W.; Oosthoek, D. P.; de Grefte, H. A. M. (Philips Gloeilampenfabrieken N. V., Eindhoven, Netherlands). Radiat. Eff.; 17: No. 1-2, 83-90(Jan 1973).

The concentration of boron implanted in silicon as a function of depth was measured by using secondary-ion mass spectrometry. In this method the silicon substrate is sputtered continuously by ion bombardment and the boron secondary ion current is measured as a function of time. The requirements that must be fulfilled to ensure that this time-dependent current represents the true concentration profile are formulated and have been checked by a number of experiments. It has been found, that under certain precautions, this is a reliable and fast method for the measurement of boron profiles. A number of boron profiles in the energy range 30 to 75 keV were measured and are discussed. Attention is paid to the range and range straggling as well as to the existence of a small tail on the profile. (auth)

8819 HIGH-RESOLUTION MEASUREMENTS OF ENERGY SPECTRA OF PROTONS SCATTERED FROM SILICON CRYSTALS

IN THE CASE OF PLANAR CHANNELING. van der Weg, W. F.; Roosendaal, H. E.; Kool, W. H. (Philips Gloeilampenfabrieken N. V.; Amsterdam). Radiat. Eff.; 17: No. 1-2, 91-97(Jan 1973).

The energy spectrum of backscattered protons in the case of incidence along several planar directions shows a fine structure near the high-energy edge. This structure, an oscillatory dependence of the probability of backscattering vs. depth in the crystal, offers a possibility to study the proton trajectory in the lattice and also to obtain the stopping power of protons near planes in silicon. Application of a simple model for the proton trajectory yields a stopping power near the planes 4 to 5 times higher than for random incidence. These effects were observed using primary energies in the range 40 to 140 KeV and for incidence along (110), (111), (100) and (112) planes. (auth)

8820 ANOMALOUS EXPANSION OF IRRADIATED FINE-GRAINED DIAMOND. Nikolaenko, V. A.; Alexeev, S. I. (Inst. Atomnoj Ehnergii, Moscow). Radiat. Eff.; 17: No. 1-2, 99-101 (Jan 1973).

The effect of grain size on the irradiation-induced expansion of diamond was experimentally shown. Under similar irradiation conditions (integral neutron flux of 1.4×10^{19} n/cm^2; E > 75 eV; temperature 130°C) 200-μm and 0.1-μm diamond powders expand up to 0.67 and 1.72%, respectively. (auth)

8821 ION IMPLANTATION DAMAGE IN GaAs MEASURED BY THE CHANNELING OF ^{85}Kr. Grant, W. A.; Baruah, J. N. (Univ. of Salford, Eng.). Radiat. Eff.; 17: No. 1-2, 13-17(Jan 1973).

Radiation damage due to implantation of ^{84}Kr in GaAs has been investigated using the dechanneling of ^{85}Kr into the ⟨110⟩ channeling direction in the crystal. The radioactive ^{85}Kr range profile, in particular its departure from that expected for ions penetrating a damage free lattice, is used as a monitor of lattice disorder. Using this technique fluence, flux and target temperature effects have been investigated. The level of damage following 40-keV Kr room-temperature implantations was found to increase with flux employed in the irradiation and consequently influences the distribution of implanted ions. A temperature of 120°C during implantation of medium-dose 40-keV Kr was sufficient to repress most of the implantation damage. (auth)

8822 TELLURIUM IMPLANTS INTO GaP AT ELEVATED TEMPERATURES: ATOM SITE LOCATION AND DAMAGE. Campbell, A. B.; Grant, W. A.; Stephens, G. A. (Univ. of Salford, Eng.). Radiat. Eff.; 17: No. 1-2, 19-24(Jan 1973).

A study has been made of the effect of substrate temperature on the lattice positions and the damage produced by Te implants into GaP. GaP crystals of ⟨111⟩ orientation were implanted with 40-keV Te ions to a dose of 5×10^{15} ions cm^{-2} at various temperatures up to 500°C and analyzed using the Rutherford backscattering technique based on channeling. Implantation damage decreases with increasing implant temperature reaching ~ 20% of the room temperature damage level following 500°C implants. The percentage of Te retained in the target decreases with target temperature up to 350°C when it has fallen to 45% of the room temperature implant level whereas above 350°C the percentage retained increases so that following implantation at 500°C it has returned to 80%. The percentage of Te occupying substitutional lattice sites increases with implant temperature and reaches a maximum of ~65% at 350°C and above. (auth)

8823 ION IMPLANTATION IN COMPOUND SEMICONDUCTORS. An Approach Based on Solid-State Theory. Heckingbottom. R.; Ambridge, T. (Post Office Research Dept., London). Radiat. Eff.; 17: No. 1-2, 31-36(Jan 1973).

The difficulties in obtaining well defined electrically active layers by ion implantation in gallium arsenide, and other binary compound semiconductors, as compared with silicon, are discussed. An examination from first principles, in terms of the chemistry of the defect solid state, points to several complications which follow immediately from the existence of two sublattices in these compounds, and it is shown that these effects may be responsible for many of the problems reported in the literature. The use of carefully matched dual implants is proposed as a technique which takes account of the special requirements of compound semiconductors, and should thus lead to improved results. The need for better characterization of the substrate material, and close control of annealing stages, in order to optimize the advantages of the technique, is also emphasized. (auth)

8824 ELECTRON SPIN RESONANCE IN ELECTRON-IRRADIATED DIAMOND ANNEALED TO HIGH TEMPERATURES. Lomer, J. N.; Wild, A. M. A. (Univ. of Reading, Eng.). Radiat. Eff.; 17: No. 1-2, 37-44(Jan 1973).

The ESR spectrum of an electron-irradiated, type-IIa diamond was studied after it had been annealed at various temperatures up to 1400°C. Six sets of lines were identified following anneals in the temperature range 700°C to 1000°C. They all arose from centres with ⟨110⟩ symmetry and a spin of 1. The centres are thought to be formed by the trapping of mobile vacancies at impurities to give chains of vacancies of various lengths in the ⟨110⟩ directions of the {110} planes. Two further spectra were observed after the 1100°C anneal. At least one of the centres has a spin of ½ and it seems likely that they were formed by some of the existing vacancy chains trapping an additional electron. Following the anneal at 1400°C, apart from an isotropic line with a g-value within 0.2% of the free-spin value, the only structure arose from centres with ⟨111⟩ symmetry. At this temperature the vacancies may break away from the impurity traps and condense in rings on the {111} planes. (auth)

8825 EFFECT OF γ IRRADIATION ON THE MAGNETIC PROPERTIES OF RUBY. Blunt, R. F.; Candela, G. A.; Forman, Richard A. (National Bureau of Standards, Washington, D. C. 20234). J. Appl. Phys. 44: No. 4, 1753-1755 (Apr 1973).

The magnetic susceptibilities of ruby samples (Cr^{3+} in α-Al_2O_3) were measured before and after Co^{60} γ irradiation. Within the experimental error the magnetic susceptibility was found to be unchanged by the irradiation. The degree of microwave saturation possible for the Cr^{3+} spin system, when at the resonance condition for complete saturation, showed a marked decrease after irradiation. Together, these results indicate that the γ irradiation has changed the resonance condition for approximately 10–15% of the Cr^{3+} in a 0.05 wt% Cr_2O_3 sample. A likely inference is that the oxidation state of at least 99% of the chromium is unaltered, and that less than 10 ppm Cr has valence differing from three in the irradiated sample. These experiments are in essential agreement with other experiments on ruby. (auth)

8826 PHOTOCONDUCTIVITY OF CHROMIUM-COMPENSATED GaAs AFTER IRRADIATION BY 0.8-MeV ELECTRONS. O'Brien, J. K.; Corelli, J. C. (Rensselaer Polytechnic Inst., Troy, NY). J. Appl. Phys.; 44: No. 4, 1921-1922(Apr 1973).

The photoconductive response to infrared light of high-resistivity chromium-compensated GaAs is examined before and after irradiation (at 300 °K) with 0.8-MeV electrons. The typical spectrum of this material is observed for the unirradiated case. After irradiation two induced levels were observed; a deep trap at E_c–1.32 eV and a level at E_c–0.54 eV. For high fluences the band gap exhibits striking changes and infrared response was no longer seen at energies below 0.52 eV. Isochronal anneals to 350 °C restored the photoconductivity spectrum to a semblance of the unirradiated case. (auth)

8827 X-RAY STUDY OF LATERAL STRAINS IN ION-IMPLANTED SILICON. Gerward, L. (Danmarks Tekniske Hoejskole, Lynby, Denmark). Z. Phys.; 259: No. 4, 313-322(1973).

Lateral strains induced by 80-keV argon ion implants into silicon were studied using x-ray interferometry and x-ray-diffraction topography. The stressed state is described by the expansion of a thin surface layer, and it is shown how it will affect the dilatational moire patterns observed in the interferograms. The integrated stress acting in the damaged layer was studied as a function of the bombardment dose. A maximum is reached at a dose of about 2×10^{14} ions/cm^2. The maximum local stress is of the order of 1×10^9 dyn/cm^2. (GE)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

8828 (COS-20) PROGRESS IN THE DEVELOPMENT OF A SYSTEM FOR THE SAFEGUARDS INSPECTION OF THE FUEL STORE OF A ZERO-ENERGY FAST REACTOR. Brown, F.; Good, P. T.; Parker, J. B.; Ross, A. E.; Terrey, D. R.; Lumetti, A.; Kerr, E.; Otomo, T.; Sultan, M. (Atomic Weapons Research Establishment, Aldermaston (England); International Atomic Energy Agency, Vienna (Austria)). Oct 1970. 40p. Dep. NTIS (U.S. Sales Only) $4.00.

A system for the safeguarding of stored fuel from a zero energy fast breeder reactor is described. Details of the instrumental procedures which must be carried out are given. (TFD)

8829 (GU-5297) ENRICHED URANIUM ACTIVE ASSAY PROGRAM. Final Report. Schamberger, R. D.; Brooks, W. L. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). 1 May 1973. Contract AT(30-1)-65. 70p. Dep. NTIS $5.50.

A project was undertaken to design, specify, procure, install, operate, and evaluate the use of a pulsed 14-MeV neutron generator in the assay of highly enriched U at a scrap recovery plant. This assay system used a sealed tube neutron generator as an interrogation source and a gated neutron detector for the delayed fission neutrons which were used as the signature for fissile material. The material being assayed was enclosed in shipping containers, usually 55- to 65-gal drums. Drums containing the sample to be assayed are raised on an elevator and simultaneously rotated by a barrel rotator so that all sections of the drum pass the neutron generator and detector. After initial operation the system was modified. The modified system operated satisfactorily for 5 months. From this experience it was concluded that the Neutron Generator Assay System is a very useful measurement facility in the commercial environment of a U scrap recovery plant. The reliability of most system components was quite satisfactory. Recommendations are made for further improving the system convenience and reliability. However, following the 5 months of operation, three accelerator tubes failed with the common symptom of excessive internal pressure. Identification and elimination of the accelerator failure mechanism is required before further application studies of the assay system are pursued. (LCL)

8830 QUANTITY CONTROL OF NUCLEAR MATERIALS IN PWR TYPE NUCLEAR POWER STATIONS. Fujii, T.; Takeura, K. (Kansai Electric Power Co. Inc., Osaka). Genshiryoku Kogyo; 18: No. 11, 33-41(Nov 1972). (In Japanese).

Quantity control, including accounting and reporting, of nuclear fuel for nuclear power generation is explained on the basis of experience in PWR power stations. It must be carried out in regard to the quantity, location, and type of the fuel accurately and systematically, utilizing means of booking, collating, tables and others; and records are further subject to safeguard inspection. The locations of the nuclear fuel for power stations are varied; namely nuclear raw material in various processing plants concerned; special nuclear material such as enriched UF_6, enriched UO_2, and plutonium compounds in the plants concerned, and nuclear substance in power stations themselves; the fuel in operation in the power stations; spent fuel in reprocessing plants; and so on. (JA)

Disposal and Storage

Refer also to abstracts 8022, 8137, 8175, 8179, 8180, and 8398.

8831 (BNWL-CC-649) DISPOSAL CHARACTERISTICS OF PLUTONIUM AND AMERICIUM IN A HIGH SALT ACID WASTE. Hajek, B. F.; Knoll, K. C. (Battelle Pacific Northwest Labs., Richland, Wash.). 10 Jun 1966. Contract AT(45-1)-1830. 13p. Dep. NTIS $3.00.

Laboratory studies show that disposal of high salt waste (AAW) waste to ground will result in plutonium and americium contamination of all soil material wetted by the waste. Both column and batch equilibrium data show that soil adsorption of plutonium and americium is low between the surface and ground water. Thus, any assumption that plutonium and americium are confined to the upper layers of soil beneath the Z-1A tile field is invalid for this type waste. Alternate disposal methods which would safely confine both plutonium and americium in a small well-defined volume should be considered. Neutralization of AAW waste by reverse strike provides an alternate method for safe ground disposal of the alkaline supernate. The sludge containing the plutonium and americium could be stored in tanks for maximum confinement, or could be stored with a high degree of safety in covered cribs. (auth)

8832 (CONF-730417-1) NUCLEAR WASTE DISPOSAL. Burch, W. D. (Oak Ridge National Lab., Tenn.). 1973. 18p. Dep. NTIS $3.00.

From 4th annual environmental pollution symposium of the American Ordnance Association; Edgewood Arsenal, Maryland, USA (4 Apr 1973).

A general review of radioactive waste disposal methods is presented. The production of high-level waste is projected to the year 2000. Emphasis is placed on geologic storage in salt formations and engineered storage in surface facilities. (TFD)

8833 (GERHTR-84) INTERIM STORAGE AND SOLIDIFICATION FOR THOREX-TYPE FISSION PRODUCT SOLUTIONS. Halaszovich, St.; Laser, M.; Merz, K. H.; Rattay, K. H.; Storch, S.; Thiele, D. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Chemische Technologie). 1972. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

Highly radioactive fission product solutions resulting from reprocessing of thorium-containing fuel elements (THOREX-Process) are interim stored in a special tank equipment at KFA Juelich. Six cylindrical tanks (1 m^3 volume each) are installed in cells built of concrete blocks. The tanks have a conical bottom, a coolant jacket, and a lid in which all pipes are fixed. In the course of reprocessing spent HTGR-fuel, a rather serious problem is the solidification and final disposal of the highly radioactive fission product waste solutions. A survey is given on the choice of a suitable process. Description of the proposed flowsheet as well as long-term storage and safety considerations are included. An alternative solidification process flowsheet developed by the German Gelsenberg Company is presented. (auth)

8834 (KFK-1789) SEPARATION, TREATMENT, AND DISPOSAL OF FISSION PRODUCT NOBLE GASES FROM NUCLEAR INSTALLATIONS. Guber, W.; Rudolph, G.; Saidl, J. (Kernforschungszentrum, Karlsruhe (West Germany)). Apr 1973. 56p. (In German). Dep. NTIS (U.S. Sales Only) $5.00.

Considerable amounts of the gaseous radioactive fission products krypton and xenon are generated from nuclear power production, forming a radiation hazard for the general public in case of uncontrolled release. The technical possibilities of separating the fission product noble gases from the offgas streams of reactors and reprocessing plants are introduced and evaluated. After a mention of possible uses, the procedures of safe fixation and final disposal are discussed. (auth)

8835 THERMAL CONSIDERATIONS AND ANALYSIS FOR A RADIOACTIVE WASTE REPOSITORY. Cheverton, R. D.; Turner, W. D. (Oak Ridge National Lab., TN). Nucl. Technol.; 19: No. 1, 21-33(Jul 1973).

Burial in bedded salt formations has been proposed as a method for permanent storage of solidified high-level radioactive wastes from nuclear reactor fuel preparation and reprocessing and other solid wastes contaminated with transuranium elements. Details of the burial scheme must be such that heat released from the wastes will not adversely affect repository operation, long-term containment integrity, fresh water aquifers, and other nearby sources of minerals. Thermal analysis of a proposed repository has helped to establish the feasibility of the basic concept and to develop a satisfactory burial scheme that will require ~600 gross acres (~1 sq mile) of ground by the year 2000. (auth)

8836 SCATTERING OF RESONANCE-LINE RADIATION IN THE LIMIT OF LARGE OPTICAL DEPTH. Harrington, J. P. (Univ. of Maryland, College Park). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 43-52(1973).

It is shown that the essential features of the transfer of resonance-line radiation in very optically thick media of low density are described by the Poisson equation. The solution of this equation is presented in the form of an eigenfunction expansion. Simple closed expressions are given for the mean number of scatterings for escape and for the line profile at both the center and surface of the medium. In the case of a medium with a finite probability of photon destruction upon scattering, the fraction of the photons which escape and the limiting intensity at the center as the optical depth tends to infinity, are obtained. These analytic results are shown to agree well with the available numerical solutions. (auth)

8837 UNINHABITED ISLETS CONSIDERED FOR DISPOSAL OF RADIOACTIVE WASTES. At. Jap.; 16: No. 10, 15-18(Oct 1972).

With the rapid advance of nuclear power generation, disposal of radioactive wastes is becoming a serious problem. Since there are many technical problems in land and ocean disposal, the Science and Technology Agency is exploring uninhabited islets as such disposal sites, and feasibility studies will start in 1973. A few candidate islets in the Japanese archipelago have already been selected on the basis of ground and terrain and also distance from populated areas. While the islets will be used for low-level wastes, the disposal of medium-level wastes must be also considered for the future. (Japan)

Handling Equipment and Procedures

Refer also to abstracts 8490 and 8842.

8838 CRITICAL ANALYSIS OF SOLUTIONS USED FOR TRANSFERS IN HIGH-ACTIVITY INSTALLATIONS. Lefort, G. (CEN, Fontenay-aux-Roses, France); Vertut, J. At. Energy Rev.; 11: No. 1, 63-152(Apr 1973). (In French).

The transfers of contaminating radioactive products across protective walls of nuclear installations become more and more important with the increase in specific activities being handled. In reality, every transport includes, as a general rule, a transfer at the beginning and another at the end of the operation; but it is during these two phases that the risks are the greatest for the personnel. The first installations treated the transfer apparatuses as integral supplements to the principal construction; they respond generally to the requirements of a single type of protection (irradiation or contamination). The development of techniques, the need for the addition of these two types of protection, and the increase in research installations have brought about, on the international plane, a proliferation of methods reserved for transfers. But there has never been an exhaustive comparison of the methods and even less a comparison of the efficiency of the equipment, their reliability, their simplicity, their rapidity of use, and the net cost of the initial installation and of its use. The present analysis, based on an extensive bibliography and on the actual knowledge of a certain number of active installations, classes the types of transfers according to their principal technological characteristics: shielded installations, confined installations, and shielded and confined installations. These different groups are themselves subdivided by direct and indirect transfer, according to whether the object transferred is transported directly so that it undergoes the transfer or by means of an auxiliary container that always remains outside the installation. This study deals principally with the case of solids, but it also takes up the known methods for the transfer of liquids, as well as the similar conditions for the entrance of personnel. In the course of this study it appeared that the economic information (efficiency, reliability, amount of contamination, cost of operation, etc.) are rarely published and are furthermore difficult to compare. Also, after indicating some tendencies that are prevalent around principal types of installations (reactors, production of radionuclides, reprocessing of irradiated fuels, etc.) a type of questionnaire is proposed that could serve as a basis for an international inquiry and would permit a better understanding of all the problems in the interest of everyone. (tr-auth)

8839 DEVICE FOR SCREWING AND UNSCREWING THE PLUG OF A CLADDING. Dalmazzone, J. (to Commissariat a l'Energie Atomique). French Patent 2,129,254. 27 Oct 1972. Filed date 19 Mar 1971. 13p. (In French).

Remote controlled equipment for screwing and unscrewing the plug of a cladding (used in a microcalorimeter) is described. It consists of a gripping device tightened by a conical part and rotated by a shaft, and a movable block in which the plug is jammed. The weight of this movable block is compensated by a compensatory spring which ensures that only a slight pressure is exerted on the cladding. In addition, the block is provided with means for moving it in the vertical plane and also means for blocking its rotation. Facilities for completely releasing the gripping device are provided. This invention is particularly useful for the packing of a radioactive source and its cladding in a container having calorimetric properties and for the preparation of this cladding and source in view of carrying out measurements. (FR)

Transportation

8840 TRANSPORT CONTAINER FOR SPENT FUEL ELEMENTS FROM REACTORS. Gruener, W.; Schubert, F. (to Siemens AG). German Patent 1,514,623. 5 Aug 1971. Filed date 22 Nov 1965. 4p. (In German).

A transport container for spent fuel elements from reactors or for other radioactive bodies is described. The container has a central chamber for the radioactive bodies which is also suitable for a supplementary coolant. There is a massive radiation shield surrounding the chamber. There is a protective layer consisting of a good heat conducting material and dense at normal environmental temperatures. This protective layer partially fills a space between the radiation shield and the external wall. In a fire occurring outside the protection vessel, the layer is so heated that it gives off gases and is transformed into a poorly conducting state. The gases escape through openings in the external wall. The material forming the protective layer evaporates under the effects of heat that the foam penetrates through the openings and coats the external walls. (JSR)

8841 PRESSURE VESSEL FOR THE STORAGE AND SHIPMENT OF PLUTONIUM COMPOUNDS IN ACID SOLUTION. Djalalian, W. H.; Guetter, H.; Knoch, W. (to Gesellschaft zur Wiederaufarbeitung von Kernbrennstoffen mbH). German Patent 1,812,952. 18 Jun 1970. Filed date 5 Dec 1968. 9p. (In German).

A vessel for the storage and shipment of acid solutions of plutonium compounds is described. The vessel is pressure resistant. Titanium was used for all parts in contact with the solutions. A three-chamber system prevents the leakage of the solutions in the case of filling and discharge, and prevents the necessity of bringing the vessel into a supplementary jacket during filling and discharge. (JSR)

8842 CRITICALITY SAFETY EVALUATION OF A SHIPPING CONTAINER FOR MODERATED LOW-ENRICHED URANIUM COMPOUNDS. Artigas, R. (General Electric Co., San Jose, CA). Nucl. Technol.; 19: No. 1, 16-20(Jul 1973).

A model is described which permits conservative homogenization of a random distribution of low-enriched UO_2 pellets in a low-enriched UO_2 powder and water mixture. The model is used with a Monte Carlo criticality code to demonstrate the criticality safety of General Electric Model BU-5 bulk uranium shipping containers which are used for the transportation of unirradiated uranium compounds in the form of powder or pellets, moderated to any degree and enriched to a maximum of 4 wt % in the ^{235}U isotope. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 9609, 9805, and 10018.

8843 (AD-751539) REPORT OF CYCLOTRON OPERATION, 1 January–31 December 1971. (Naval Research Lab., Washington, D. C.). Oct 1972. 55p. (NRL-MR-2518). NTIS.

Topics include basic research program (few-nucleon systems); light nuclei; deformed nuclei; direct reactions; alpha scattering; applications research program (helium implantation); trace assay; radioisotope production; neutron radiotherapy; space applications; and the data acquisition system. (NTIS)

8844 (AD-752762) SNARK ELECTRON BEAM DEVELOPMENT FOR MATERIALS AND STRUCTURES IRRADIATION. Final Report, December 1970–January 1972. Shope, S.; Spence, P.; Stallings, C. (Physics International Co., San Leandro, Calif.). Nov 1972. Contract DASA01-71-C-0045. 111p. (PIFR-301; DNA-2932-F). NTIS.

The development of electron beam irradiation capabilities on the Defense Nuclear Agency (DNA) SNARK facility for use in materials and structures testing is described. Both large (about 100 cm^2) and small (about 10 cm^2) irradiation areas are discussed. Electron beam generation and control for this work was accomplished by use of external pulsed magnetic guide fields. Details of the beam transport work are given along with descriptions of several pilot material and structural response experiments. The longitudinal guide field approach is shown to be an efficient (≥75%) technique for energy extraction (in a useable fashion) from high-current pulsed electron accelerators. Potential applications of this approach to other generators are also discussed. (auth)

8845 (LA-5262-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending January 31, 1973. Dunn, E. (comp.) (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 49p. Dep. NTIS $5.45.

Work this quarter has been directed toward developing the experimental areas and improving the reliability and reproducibility of accelerator operations, and toward increasing beam intensity without excessive beam spill. The first use of experimental targets in Area A is planned in June. Periods of continuous operation of the accelerator increased from 5 to 12 days this quarter. Transmission of beam to the temporary beam stop in the switchyard was achieved; average beam currents were of the order 1 μA and beam energy ranged from 211 to 447 MeV. Work has continued on the construction of the biomed beam channel, with the expectation that tuning operations may begin after the first 1-μA beam is delivered to the beam stop. Phase II design of the biomedical facility building was submitted for review. The suggested changes, additions, and deletions have been forwarded to the architect-engineering firm. (auth)

8846 (LBL-1698) CONSIDERATIONS OF BEAM QUALITY REQUIREMENTS FOR EXPERIMENTS WITH VERY HEAVY IONS. Alonso, J. R.; Harvey, B. G. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 30p. Dep. NTIS $4.00.

Factors that limit the attainable resolution in certain heavy-ion experiments were examined. It has been stated that beam quality from accelerators such as the SuperHILAC will often prove to be a very serious limitation. It is shown that other, purely experimental factors are likely to impose considerably more severe limitations. The emphasis of this study has been placed on particle spectroscopy experiments because of the tremendous popularity and success of this technique in recent years, and because such experiments probably place the most severe requirements on beam quality. However, future experiments in heavy-ion physics may well be based mainly on different techniques, with less severe beam quality requirements. Some beam properties of existing heavy-ion accelerators at LBL are discussed, and some of the experimental problems which must be considered are detailed. (auth)

8847 (LYCEN-7266) BIBLIOGRAPHIC STUDY OF THE CAUSES OF ENERGY FLUCTUATIONS IN A VAN DE GRAAFF ACCELERATOR. Tholomier, M.; Gaillard, M. (Lyon Univ. (France). Institut de Physique Nucleaire). Oct 1972. 11p. (In French). Dep. NTIS (U.S. Sales Only) $3.00.

The causes of energy fluctuations in a Van de Graaff accelerator are reviewed: variations in the equivalent resistance between the emitting comb and the belt; fluctuations in the belt charge current; self excitation charges; effect of the way in which the belt was manufactured; mechanical oscillation effects; generation of charges in the accelerator tube; effect of alternator harmonics (inadequacy of the servo-loop pass-bands); and induction effects. (FR)

8848 (RLO-2230-T-4-84) PARTICLE ACCELERATOR UTILIZING TEMPLATE MODULATED COHERENT LIGHT ENHANCED BY OPTICAL RESONATOR. Csonka, P. L. (Oregon Univ., Eugene). 1972. 45p. Dep. NTIS $4.25.

The acceleration of charged particles by coherent laser radiation using templates for modulating the radiation was studied. Template design, the possibility of particle acceleration without using mirrors, and reduction of laser requirements by multiply reflecting the radiation are discussed. Conceptual design parameters of an accelerator are calculated. (WHK)

8849 IMPROVEMENT TO MEDICAL RADIATION DEVICES USING PARTICLE ACCELERATORS. Lacaze, R. (to Thomson CSF). French Patent 2,123,208. 8 Sep 1972. Filed date 29 Jan 1971. 4p. (In French).

This medical irradiation device which is supported by a platform includes a particle accelerator and a treatment table. The exit of the accelerator is provided with a magnetic deviation block which forms a double elbowed guide capable of rotating about an axis coincident with that of the accelerator and parallel to the rectilinear part of the guide between the two elbows. The support of the treatment table is adjustable. It is positioned from the platform at a distance equal to that separating the axis from the platform and less than that separating the axis from the rectilinear part of the guide. A pit is provided in the platform beneath the block such that the complete rotation of the block is possible. Means are envisaged for blocking off this pit in the case where the rectilinear part extends above the level of the platform. (FR)

8850 NONLINEAR THEORY OF A RELATIVISTIC MONOTRON. Smorgonskii, A. V. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 1, 150-155(1973). (In Russian).

The maximum efficiency of the relativistic monotron was calculated on the basis of analyzing the electron motion in the field of a strong electromagnetic wave. The optimal parameter values of the device and the admissible electron energy distribution were determined. It is shown that in the region of the parameter values at which the high efficiency is achieved the operating currents exceed the starting ones. (auth)

8851 LINEAR ELECTRON ACCELERATORS AT THE MOSCOW ENGINEERING-PHYSICS INSTITUTE. Val'dner, O. A. (Moscow Engineering-Physics Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 14-22(1972). (In Russian).

Operating characteristics and performance are described for certain linear electron accelerators located at the Moscow Engineering Physics Institute. (KSW)

8852 RADIATION DEVICES AT THE TOMSK POLYTECHNIC INSTITUTE. Didenko, A. N. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 23-31(1972). (In Russian).

Summaries of the operational characteristics are given for the 1.5 GeV electron synchrotron, wave-guide synchrotrons, microtrons, induction accelerators, powerful nanosecond accelerators, a 120-cm (pole diameter) cyclotron, a 2.5 MeV electrostatic generator, and a 2.5 MW nuclear reactor. These facilities are all in current use at Tomsk Polytechnical Institute. (KSW)

8853 PLANNING NEW ACCELERATORS AND PROBLEMS OF MODERN ELEMENTARY PARTICLE PHYSICS. Blokhintsev, D. I.; Efremov, A. V.; Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Usp. Fiz. Nauk; 109: No. 2, 259-268 (Feb 1973). (In Russian).

Current work with the 76 GeV proton accelerator at Serpukhov, the 20 GeV electron accelerator at Stanford, and the PEP project in California are reviewed. A discussion of the research in elementary particle physics including the "elementary line," unusual particles, very strong interactions, electromagnetic interactions, and weak interactions (four-fermion vs the intermediate boson theories) is given. A brief survey of future accelerators includes modernization of existing machines for the purpose of boosting the intensities of both primary and secondary beams, the design of >1000 GeV proton accelerators, the generation of high-energy lepton beams and secondary hadron beams, and the production of 300 GeV counter beams of $e\bar{e}$, $\mu\bar{\mu}$, and $p\bar{p}$, and relativistic multicharged ions. (KSW)

8854 RELATIVISTIC ACCELERATION OF CHARGED PARTICLES BY SUPERINTENSE LASER BEAMS. Kaw, P. K.; Kulsrud, R. M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 2, 321-328 (Feb 1973).

The relativistic motion of charged particles in very intense electromagnetic wave pulses with slowly space-varying amplitude has been analytically investigated. The results of the analysis have been used to discuss the conditions under which currently available lasers can be used for producing MeV electrons in the laboratory. (auth)

8855 JAERI NEW LINAC. Asami, A. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 15: No. 1, 37-42(Jan 1973). (In Japanese).

A new linear accelerator, the design and construction of which have been the subject of work at the Japan Atomic Energy Research Institute for 2 years from 1970, is described together with its performance to date. The machine was test operated from April to August 1972, followed in September by experiments using the accelerator. The accelerating waveguides are in five sections, two of which have a length of 2 m each, the remainder being 3 m long each. The design characteristics of the electron beam are, for a maximum peak microwave power of 20 MW with a frequency of 2,857 MHz fed into each accelerating section: 180 MeV maximum energy with zero current, and 80 MeV with 600 mA for a pulsewidth of 2 μsec. The pulsewidth is variable from 5 nsec to 2 μsec, with a range of pulse repetition from 50 to 600 pps. The beam actually obtained in the test operation roughly satisfied the above design characteristics. A short expansion is given of the accelerating waveguide sections, the microwave system, the pulsars, the electron injector, the beam transport system, the vacuum and cooling systems, and the annexed computer. In addition, experimental facilities to be used with the linac are briefly described. (auth)

8856 MEASURING OF THE RADIATION FIELD OF A PMB-6 TYPE BETATRON. Benko, L. (MTA Izotop Intezete, Budapest). Izotoptechnika; 16: No. 3, 159-172(Mar 1973). (In Hungarian).

Topics discussed include physical principles of betatron operation; determination of dose rate distribution of the bremsstrahlung; dose rate field in the betatron environment; and personnel dosimetry. (auth)

8857 VARIABLE ENERGY LINEAR ACCELERATOR FOR HEAVY PARTICLES. Leboutet, H.; Duc Tien, T. (to Thomson CSF). French Patent 2,127,228. 13 Oct 1972. Filed date 1 Mar 1971. 9p. (In French).

A device for accelerating charged particles is presented. It consists of an elongated conducting element to which the drift tubes are fixed by means of rods, and another part of which can be mechanically displaced in relation to the first element such that the phase velocity can be altered and the energy of the emerging particles thus varied. (FR)

8858 IMPROVEMENT FOR CYCLOTRONS. Delphin, P. (to Compagnie Generale de Telegraphie Sans Fil). French Patent 96,428. 23 May 1972. Filed date 22 Nov 1968. 3p. (In French)

A description is given of a cyclotron having dees with azimuthal apertures of less than 180 deg. The dees are capacitively coupled by at least one fixed electrode which is electrically connected to one of the dees and extends parallel to the dees in such a way as to partially cover them. (FR)

8859 IMPROVEMENTS TO HIGH CURRENT LINEAR ACCELERATORS. Epsztein, B.; Duc Tien Tran. (To Thomson-CSF). French Patent 2,127,186. 13 Oct 1972. Filed date 26 Feb 1971. 15p. (In French).

A particle accelerating unit for a linear accelerator is presented. It consists of a group of successive cavities having significantly different oscillation eigenfrequencies. Means are provided for varying the frequency and the phase of the injected h-f energy in each of the cavities. In this way, a smoothing out of the energy acquired by each of the packets crossing the unit is obtained. (FR)

Auxiliaries and Components

8860 (AD-755510) ACCELERATOR RADIATION PROTECTION. Martin, T. G. III (Army Natick Labs., Mass.). Jun 1972. 195p. (FL-169; USA-NLABS-TR-73-7-FL). NTIS

The eight chapters of the report cover much of the material needed in the evaluation of design and operational safety for particle accelerators below 40 to 50 MeV. Each chapter deals with a phase of the problem such as x-ray shielding, neutron shielding, and induced radioactivity. (auth)

8861 (JINR-P16-7036) METHOD OF CALCULATING THE PROTON LOSSES AFTER INTERACTION WITH THE TARGETS OF CYCLIC ACCELERATORS. Vasilishin, B. V.; Zaitsev, L. N.; Petoyan, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR), Lab. of High Energy). 1973. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The method is presented for calculating the proton losses at large distances from the targets of ring accelerators. The distribution function is obtained for the proton losses for the synchrophasotron at the beam kink on the magnet septum of the slow extraction system. The method is applicable for calculating the radiation conditions around accelerators. (auth)

8862 (LBL-1398) CHROMONITOR, A COLORFUL DYNAMIC GRAPHIC DISPLAY TERMINAL. Lothrop, F. H. G. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 3p. (CONF-730310-57). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The Bevatron has associated with its acceleration cycle many parameters which vary in a dynamic manner throughout that cycle. Control and monitoring of such parameters is now done largely by computer, so that many variables formerly in the analog realm and easily observed on the conventional oscilloscope are now in the digital realm and not easily observed. The Chromonitor is a device which has been developed to accept inputs from computers or the analog realm and display on a TV screen any or all of sixteen different parameters which may be associated with particle acceleration and delivery, or which may be pertinent to monitoring a computer process in progress. Each of the parameters may be displayed in any of seven colors. (auth)

8863 (RHEL/M/A-25) SUPERCONDUCTOR CABLES FOR PULSED DIPOLE MAGNETS. Gallagher-Daggitt, G. E. (Rutherford High Energy Lab., Chilton (England)). Feb 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

Superconductor cables employed in the construction of the RHEL series of superconducting dipole magnets ACIII, IV and V have undergone a process of evolution stimulated by the development of three component filamentary composite conductors having improved properties and ever increasing numbers of filaments. This evolution which has culminated in the development of the current "Flat 15" type cable which is to be used in the construction of the next generation of pulsed superconducting dipole magnets is traced. The manufacturing process employed in the construction of these cables is also briefly described. (auth)

Ion Sources and Injection and Extraction Systems

8864 (GSI-tr-72/15) REMOTE CONTROL SYSTEM FOR AN ION SOURCE AT THE PREINJECTOR OF THE LINAC I 100. Maltsev, I. G. (Gesellschaft fuer Schwerionenforschung, Darmstadt (West Germany)). Jul 1972. Translation of. (INZH-71-82). 8p. INIS.

In pulsed, electrostatic accelerators, synchronizing impulses have to be used to synchronize the ion source, as well as control signals for controlling the supply to the pulsed ion source which is coupled to the high accelerator potential. The high noise levels occurring due to the high power requirement of the accelerator call for a reliable long-term operation of the remote control system. Systems operating with photoconductors will guarantee particularly steady and reliable signal transmission, even in the presence of considerable potential differences and noise levels. Remote control systems using photoconductors together with glow discharge lamps and lamps with luminous anodes are rather complicated and uneconomic and offer but little operating reserves. The development of semiconducting luminous diodes offers the possibility to realize photo-conductive systems with substantial operating reserves, and the high lighting frequency allows for economic multi-channel systems for signal transmission. (INIS)

8865 (JAERI-M-5032) ACCELERATION OF NITROGEN IONS BY 2 MV VAN DE GRAAFF ACCELERATOR. Kobayashi, C.; Kanda, S. (Japan Atomic Energy Research Inst., Tokyo). Nov 1972. 16p. (In Japanese). NTIS (U.S. Sales Only).

Nitrogen ions were accelerated by the JAERI 2-MV Van de Graaff accelerator. The energy and intensity of the available nitrogen ions (N^+) were 0.7 MeV and 6 μA, respectively, at the target position. These values are sufficient for some experiments on radiation damage. The existing RF-type ion source was used for this purpose, so that conversion to the proton or deuteron accel-

eration can be easily carried out with little modification of the high-voltage terminal. The lifetime of the ion source is about 1000 h. The acceleration of heavy ions to higher energy and more intensity is realized simply by improving the vacuum system and increasing the power of the analyzing magnet. (auth)

Ion Optics and Field Calculations

8866 (BNL-17815) TRANSVERSE RESISTIVE WALL INSTABILITY FOR A WARM ISA. Month, M. (Brookhaven National Lab., Upton, N. Y.). 18 Apr 1973. 5p. Dep. NTIS $3.00.

The transverse dipole resistive wall instability is considered. A comparison is made between a "cold" and "warm" ISA design. It is concluded that there are strong constraints on the amount that the synchrotron radius can be increased and on the amount that the magnet gap can be decreased when the warm case is designed. A reasonable warm design, from the point of view of economically achievable magnetic field, is chosen as an example. It is concluded, however, that such a design is untenable. Although, when the beam width is larger than the magnet gap, the requirement on ν-spread is reduced, it is found that the reduction is not sufficient to compensate for the effect of increased radius and decreased gap. (auth)

8867 (BNL-17892) EFFECT OF BEAM WIDTH ON THE INCOHERENT ν-SHIFT DUE TO IMAGE FORCES. Month, M.; Gluckstern, R. L. (Brookhaven National Lab., Upton, N. Y.). 1 May 1973. 22p. Dep. NTIS $3.25.

The effect of the distribution of charge in a beam of particles on the space-charge ν-shift is considered. At high energy, the major contribution to the space-charge ν-shift comes from the image fields created by the presence of metallic and ferromagnetic boundaries. For beams small with respect to chamber and magnet dimensions, a point source treatment of the beam is adequate. However, when the beam width is comparable to or greater than the chamber height, the distribution of charge cannot be neglected. To study this effect, a rectangular geometry is used. A conducting vacuum chamber, a parallel plate ferromagnetic surface and a coasting ribbon beam are assumed. It is found that for a large beam size, a, relative to chamber height, h (or magnet gap, g), the image-tune-shift has a 1/ah asymptotic behavior, and not $1/a^2$, which might appear to be reasonable from image source arguments. The nonuniformity of the ν-shift along the beam is also considered in detail. It is interesting that the unexpected appearance of the transverse resistive wall instability in the CERN ISR, the "brickwall" effect, has been attributed to such a condition in the stacked beam. Finally, numerical computations are performed in order to demonstrate the influence on the image-tune shift of (1) the chamber side walls, and (2) the rate of fall-off of the horizontal charge density distribution. It is found that the main effect of bringing the sidewalls near the beam and/or softening the fall-off of the charge density distribution is an increase in the spread of ν-shifts across the horizontal width of the beam. (auth)

8868 (IPP-0/11) NUMERICAL CALCULATIONS OF THE ELECTRON INFLECTION INTO A COMPRESSOR WITH AN ADDITIONAL B_ϕ-FIELD. Luccio, A. U.; Schumacher, U.; Springmann, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). May 1972. 11p. (In German). INIS.

Numerical calculations of the inflection process of electrons into an electron-ring accelerator compressor with an additional B_ϕ-field are presented. It is shown that, by choosing suitable values for the initial mean axial position and velocity, compact electron rings can be formed (i.e., the final betatron amplitudes can be made small). (INIS)

8869 (JINR-P9-7064) SCREENING OF THE ALTERNATIVE MAGNETIC FIELD IN COAXIAL SYSTEM OF TUBES WITH FINITE CONDUCTIVITY. Mamonov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 10p. (In Russian). Dept. NTIS (U. S. Sales Only) $3.00.

Screening of the alternative homogeneous magnetic field by the walls of a coaxial structure is considered for the case of a linear collective accelerator. Expressions are found connecting the electric and magnetic fields in all the regions of the system. Specific examples are presented. (auth)

8870 (JINR-P9-7066) STABILITY OF COHERENT OSCILLATIONS OF AN ELECTRON RING IN RESONATOR. PART II. Transverse Oscillations. Aleksakhin, Yu. I.; Korenev, I. L.; Vudin, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 18p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The resonance and resistance instabilities of transverse oscillations of a beam in a cylindrical resonator were studied. It was shown that the most dangerous are the lowest resonance modes of axial oscillations. (auth)

8871 (LYCEN-7261) PROGRAMS FOR THEORETICAL CALCULATIONS OF CERTAIN SIMPLIFIED PERIODIC STRUCTURES. Voisin, G. (Lyon Univ. (France). Institut de Physique Nucleaire). Sep 1972. 56p. (In French). Dep. NTIS (U.S. Sales Only) $5.00.

Computer programs for calculating periodic structures are presented. Studies of a particular structure are divided into three parts: calculation of the arguments of the transverse eigen functions used for the different sections of the structure, their norms, and the coupling integrals in the joining planes; the establishment of dispersion curves and calculations of the coefficients of field expansions (with the eigenfunctions used) for given modes; and utilization of the expansion coefficients obtained to study the field in certain interesting regions of the structure. Certain programs explicitly involve the transverse geometry of the structure (e.g., drift tube structures), while other programs are valid for a more general class of structures presenting a simple or interdigital type periodicity. (FR)

8872 EFFECT OF LOCAL INHOMOGENEITIES OF A PERIODIC MAGNETIC FIELD ON PULSATIONS OF ELECTRON BEAMS. Bakhrakh, L. E.; Zolotarev, E. L.; Murzin, V. V. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 7, 1160-1166(Jul 1972).

Translated from Radiotekh. Elektron.; 17: No. 7, 1479-1486 (Jul 1972).

The effect of different inhomogeneities of a focusing periodic magnetic field which are localized in one cell of a magnetic periodic focusing system (MPFS) on pulsations of electron beams is discussed with the radial dependence of the axial component of magnetic induction taken into account. It is shown that it is possible to apply the approximate method of calculation of local inhomogeneities. The results of calculation using a computer and experimental data are presented. (auth)

8873 QUANTUM THEORY OF THE MOTION OF RELATIVISTIC ELECTRONS IN CROSSED MAGNETIC AND ELECTRIC FIELDS OF THE FOCUSING TYPE. Zhukovskii, V. Ch.; Kholomai, B. V. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 12, 32-37(1972). (In Russian).

A solution to the Dirac equation for a weak electrical field was found within an approximation of harmonic oscillations. In this, the electrical field effected an axial focusing of electrons in a homogeneous magnetic field. With the aid of the resulting wave functions, the radiation-induced polarization of electrons was investigated. (tr-auth)

Storage Rings

8874 (BNL-17813) TOLERANCES FOR QUADRUPOLES IN A SUPERCONDUCTING STORAGE ACCELERATOR. Parzen, G. (Brookhaven National Lab., Upton, N. Y.). 2 Apr 1973. 9p. Dep. NTIS $3.00.

Tolerances for the magnetic field errors in the quadrupoles of a superconducting storage accelerator are proposed. Systematic errors in the magnetic field and random errors in the magnetic field are considered. (auth)

8875 (BNL-17893) NONLINEAR TUNE SHIFT DUE TO THE LONG RANGE BEAM-BEAM INTERACTION. Month, M.; Courant, E. D. (Brookhaven National Lab., Upton, N. Y.). 1 May 1973. 17p. Dep. NTIS $3.00.

The long-range interaction of colliding particle beams in the weak-strong limit is considered. The linear and nonlinear ν-shifts are calculated using both uniform density beams and Gaussian beams. In particular, two limiting cases are detailed. In the case of large crossing angles, the beams are effectively separated in the long-range region. The relevant condition is $\alpha > \sigma_0/\beta_0$ (or, $\eta_0 > 1$), where α is the crossing angle, while β_0 and σ_0 are respectively the β value and the half-beam-size at the crossing point. The other limiting case is that of small η_0 ($\eta_0 < 1$), which corresponds physically to the situation where the test particle does not cross the "strong" beam at a crossing angle sufficiently large to escape the expanding envelope. The beams are therefore not properly separated in the long-range region. It is concluded that, except in the case η_0 much larger than one, the linear ν-shift is a true reflection of the nonlinear interaction in the long-range region. In rough terms, then, scaling applies. The precise meaning of scaling in the long-range region is discussed. However, for moderate $\eta_0 > 1$, the long-range linear ν-shift changes sign. This could lead to an underestimate of harmful nonlinear effects. It is found that for $\eta_0 < 1$ the nonlinear terms are sensitive to the density distribution

in the long-range region. For low multipole order, n, they are generally smaller for uniform beam densities than for Gaussian densities. For $\eta_0 > 1$, there is no such sensitivity as a consequence of the fact that the beams are separated in the long-range region. It is finally pointed out that in attempting to limit the beam–beam interaction by separating the beams, then either the crossing angle must be sufficiently large ($\alpha > \sigma_0/\beta_0$), or the beams must be separated by externally imposed means, i.e., they may be bent apart by sufficiently strong bending magnets, or the interaction region may be limited by keeping the beams bunched. (auth)

Experimental Facilities

Refer also to abstracts 8192 and 9578.

8876 (LBL–1375) PROBLEMS IN DESIGN AND OPERATION OF SUPERHILAC BEAM TRANSPORT SYSTEMS. Selph, F. B. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 7p. (CONF-730310–58). Dep. NTIS $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The plan for the SuperHilac experimental area beam lines is given; the design emittance of transport lines is discussed; and operating experiences are related. Steering effects, including tuning the focusing properties of the transport line and alignment, are discussed; and the beam monitoring instruments are briefly described. (WHK)

8877 (SLA–73-609) NEUTRON GENERATOR WITH A VACUUM SYSTEM INCORPORATING AN ION GETTER PUMP. Istvan, P. Translated from Finommechanika; 11: 229-232 (1972). 13p. Dep. NTIS $3.00.

The earlier neutron generators that incorporated an oil diffusion pump and the new neutron generators which incorporate an ion getter pump, with special reference to their construction, characteristics, advantages, and disadvantages, together with experience gained in their operation are discussed. (auth)

8878 APPARATUS FOR THE STUDY OF LOW ENERGY ION BACKSCATTERING FROM SOLID TARGETS. Andrew, R.; Riley, M.; Armour, D. G.; Carter, G. (Univ. of Salford, Eng.). Vacuum; 22: No. 11, 587-593(Nov 1972).

When energetic ions strike the surface of a solid target, a fraction, depending on the ion energy and other parameters, penetrates the surface, while the remainder are reflected. Experimental studies of ion reflection have shown that this phenomenon is extremely sensitive to both the structure and composition of the surface; and measurements of the energy and angular distributions of backscattered ions, particularly at high energies, have been extensively employed to investigate such features as the composition of the surface and near surface layers of a solid, the location of impurity atoms in a lattice, and the orientation and crystallinity of a solid. In the incident ion energy range below about 5 keV, in which the backscattering phenomena are most sensitive to the condition of the surface, the considerable influence of experimental parameters such as target preparation technique and residual gas pressure in the target environment makes meaningful study difficult. An apparatus that has been constructed to carry out a comprehensive study of the energy and angular distributions of low energy (50 eV to 2 keV) rare gas ions incident on the surfaces of solid targets is described. This type of study requires that a well-collimated, mono-energetic, mass analyzed ion beam should be incident on an atomically clean and smooth target surface and that both the target and detector should be movable inside the ultra-high vacuum scattering chamber. In addition to briefly reviewing the surface probing techniques currently in use, the ion gun, manipulation systems and vacuum apparatus that have been used in the construction of the low energy ion backscattering system are described. (auth)

8879 APPLICATIONS OF SYNCHROTRON RADIATION. Codling, K. (Univ. of Reading, Eng.). Rep. Progr. Phys.; 36: No. 5, 541-624(1973).

The major loss mechanism in synchrotrons is the radiation emitted by the electrons as they accelerate to high energies. This synchrotron radiation has been put to great use in recent years as a source of pure continuum for the extreme ultraviolet (XUV) spectral region (10 to 1000 Å). The theory of synchrotron radiation is well understood. Those aspects relevant to its application as an XUV light source are reviewed, and this unique source is compared with conventional XUV light sources. A number of spectrometers are described that have been developed specifically for use with synchrotron radiation that overcome some of the problems inherent in utilizing such sources. The greater part of the review describes experiments in atomic, molecular and solid state spectroscopy that have benefited substantially from the application of these intense, highly polarized XUV continua. The wavelength distribution of intensity of the synchrotron radiation can be calculated from known accelerator parameters if the total number of orbiting electrons can be determined. Synchrotrons can hopefully become absolute standards of intensity throughout the XUV spectral region. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstract 9125.

8880 (AD-752582) REPORT ON ELECTRONIC AND IONIC REACTIONS IN ATMOSPHERIC GASES. Final Report. Neynaber, R. H.; Rutherford, J. A.; Vroom, D. A. (Gulf Radiation Technology, San Diego, Calif.). Jul 1972. Contract DNA001-72-C-0254. 118p. (GULF-RT-A-12209; DNA-2944-F). NTIS.

The effect of addition on internal energy to the ion or neutral reactant in an ion–neutral process was investigated. Changes in the cross section for certain processes are reported and a change in the state of excitation of the final product can in some cases be postulated. The reactions between $O^+ + N_2$, $N^+ + N_2$, $N^+ + O_2$, $N_2^+ + O_2$, and $N_2^+ + O$ were considered. Where the cross section was found to increase with additional of internal energy to either the ion or the neutral, an approach to near resonance was, in some cases, found to have occurred. In such cases one or the other of the product particles may be produced in an excited state. When the internal energy change is small compared to the energy defect for the reaction, little or no change in the cross section was observed. (auth) (NTIS)

8881 (BUP-42) COSMIC RAY 27-DAY RECURRENCES DURING 1965–69. Aksland, A. M.; Amundsen, R. (Bergen Univ. (Norway). Dept. of Physics). Jun 1972. 26p. INIS.

The 27-day variation in neutron monitor data was analyzed according to three methods of analysis, autocorrelation, Chree, and power spectrum analysis. The years 1965–69 were investigated, i.e., the period from minimum to maximum activity in solar cycle No. 20. The periodic length of the 27-day recurrences was found to decrease from 31.5 days during start of cycle to 27.5 days towards maximum of activity. The most persistent recurrences occurred during 1967–1968. The amplitude was found to vary with the level of solar activity; it was lowest during the start of the new cycle and increased with increasing activity towards a limit reached in 1966. The amplitude was kept roughly at this value for $3\frac{1}{2}$ years onwards, while the solar activity steadily increased, and indicates a saturation of the modulation. The cosmic-ray 27-day recurrences were compared with corresponding variations found in solar-wind speed, interplanetary field direction, photospheric field and coronal line (λ 5303) intensity, and phase relations with geomagnetic activity and solar activity. The dependence of the modulation on the rigidity p could roughly be approximated by the form p^{-a}, with $a \sim 0.4$ to 0.7. (auth)

8882 (HASL–275) LUIN, A CODE FOR THE CALCULATION OF COSMIC RAY PROPAGATION IN THE ATMOSPHERE. O'Brien, K. (Health and Safety Lab. (AEC), New York). May 1973. 23p. Dep. NTIS $4.00.

An analytical straight-ahead transport code, LUIN, was developed for the calculation of cosmic-ray spectra, fluxes, and ionization in the Earth's atmosphere. The input to the code is described, along with an ancillary code to prepare the angle-dependent rigidity cut-off input. LUIN takes into account solar modulation, the geomagnetic field, atmospheric temperature, altitude, and the curvature of the Earth. The code is written in FORTRAN IV for the CDC 6600. (auth)

8883 (N-73-15837) QUANTITATIVE INVESTIGATION OF THE SOLAR MODULATION OF COSMIC-RAY PROTONS AND HELIUM NUCLEI. Garrard, T. L. (California Inst. of Tech., Pasadena). 19 Jun 1972. 233p. (NASA-CR-130298). NTIS.

Thesis.

The differential energy spectra of cosmic-ray protons and He nuclei were measured at energies up to 315 MeV/Nucleon using balloon-borne and satellite-borne instruments. These spectra are presented for solar quiet times for the years 1966 through 1970. The data analysis is verified by extensive accelerator calibrations of the detector systems and by calculations and measurements of the production of secondary protons in the atmosphere. The spectra of protons and He nuclei in this energy range are dominated by the solar modulation of the local interstellar spectra. Numerical solutions to the transport equation are presented for a wide range of parameters. (auth) (STAR)

8884 (ORNL-TM–3877) MEASUREMENT OF THE NEUTRON ENERGY SPECTRUM AT 9 g/cm² RESIDUAL ATMOSPHERE. Zobel, W.; Love, T. A.; DeLorenzo, J. R.; McNew, C. O.; Baldry, R. H.; Parker, H. W. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 43p. Dep. NTIS $4.25.

An experiment to measure the neutron energy spectrum at an altitude corresponding to 9 g/cm² residual atmosphere was performed near solar maximum. The nondirectional spectrometer employed was flown at geomagnetic latitude 40° N from Palestine, Texas, on June 17, 1969. The experimental arrangement is described, the data reduction scheme is discussed, and the results are presented for the neutron spectrum in the energy range from 3 to 60 MeV. The spectrum is compared with those from other experiments and from calculations. The intensity is greater than the calculations of Lingenfelter after application of an altitude correction, but is lower than the measurement of Preszler, Simnett, and White and the calculations of Armstrong, Chandler, and Barish. (auth)

8885 AEONIC FLUX OF ULTRA-ENERGETIC COSMIC RAYS. Van Loon, L. G. Nuovo Cim.; 14B: No. 2, 267-283(11 Apr 1973).

Recently it has been found that cosmic-ray interactions at ultra-high energy leave visible marks of more than several micron in lunar-rock minerals. The method for determining the energy of these interactions is given and the cosmic-ray flux in past aeons is determined. It is found on the basis of the present experiment that the random cosmic-ray intensity has not varied enormously during lunar history. (auth)

8886 MINOR AND TRACE ELEMENTS IN SOME METEORITIC MINERALS. Allen, R. O.; Mason, B. (Univ. of Virginia, Charlottesville). Geochim. Cosmochim. Acta; 37: No. 6, 1435-1456(Jun 1973).

The mineral phases including olivine, orthopyroxene, clinopyroxene, troilite, nickel-iron, plagioclase, chromite, and the phosphates were separated from several meteorites. These were a hypersthene chondrite (Modoc), a bronzite chondrite (Guarena), an enstatite chondrite (Khairpur), and two eucrites (Haraiya and Moore County); diopside was separated from the Nakhla achondrite. The purified minerals were analyzed for trace and minor elements by spark source mass spectrometry and instrumental neutron activation analysis. On the meteorites examined the results show that Co, Ni, Cu, Ge, As, Ru, Rh, Pd, Sn, Sb, W, Re, Os, Ir, Pt, and Au are entirely or almost entirely siderophile; Na, Rb, Sr, Y, Ba, and the rare earth elements lithophile; Se chalcophile. The transition elements Sc, Ti, V, Cr, and Mn are lithophile in most stony meteorites, but show chalcophile affinities in the enstatite chondrites (and enstatite achondrites), as do Zn, Zr, and Nb. In the ordinary chondrites Ga shows both lithophile and siderophile affinities, but becomes entirely siderophile in the enstatite chondrites. Molybdenum and tellurium show strong siderophile and weaker chalcophile affinity. The lithophile elements are distributed among the minerals according to the crystallochemical factors, the most effective controlling factor being ionic size. (auth)

8887 FERMI MECHANISM AND THE SOURCE SPECTRUM OF COSMIC RAY NUCLEI. Ramadurai, S.; Biswas, S. (Tata Inst. of Fundamental Research, Bombay, India). Astrophys. Space Sci.; 17: No. 2, 467-471(Aug 1972).

It is shown that the velocity term, occurring in the expression for the rate of energy gain by the Fermi mechanism of acceleration, is to be taken into account in case of acceleration of non-relativistic particles. A spectral form of accelerated particles is derived on this basis and is called the "Fermi spectrum." At nonrelativistic energies this spectral form is significantly different from the currently used forms of power law in total energy per nucleon and in rigidity, and lies about midway between them. It is shown that using this form of source spectrum of cosmic-ray nuclei, satisfactory agreement can be obtained between the calculated values and the observed ones of the ratios of $^2H/^4He$ and $^3He/^4He$, and the energy spectra of protons and helium nuclei near the Earth. (auth)

8888 GALACTIC COSMIC-RAY MODULATION FROM 1965 TO 1970. Urch, I. H.; Gleeson, L. J. (Monash Univ., Clayton, Australia). Astrophys. Space Sci.; 17: No. 2, 426-446(Aug 1972).

Numerical solutions of the cosmic-ray equation of transport within the solar cavity and including the effects of diffusion, convection, and energy losses due to adiabatic deceleration, were used to reproduce the modulation of galactic electrons, protons, and helium nuclei observed during the period 1965–1970. Kinetic energies between 10 and 10^4 MeV/N were considered. Computed and observed spectra (where data were available) are given for the years 1965, 1968, 1969, and 1970 together with the diffusion coefficients. These diffusion coefficients were assumed to be of

separable form in rigidity and radial dependence, and were consistent with the available magnetic-field power spectra. The force-field solutions are given for these diffusion coefficients and galactic spectra and compared with the numerical solutions. For each of the above years (i) the radial density gradients near Earth were determined; (ii) the mean energy losses suffered by galactic particles as they diffuse to the vicinity of the Earth's orbit were found; (iii) quantitatively the exclusion of low-energy galactic protons and helium nuclei from near Earth by convective effects is shown; and (iv), for nuclei of a given energy near Earth, their distribution in energy before entering the solar cavity was obtained. It is shown that the energy losses and convection lead to near-Earth nuclei spectra at kinetic energies ≤100 MeV/N in which the differential intensity is proportional to the kinetic energy with little dependence on the form of the galactic spectrum. This dependence is in agreement with the observed spectra of all species of atomic nuclei and it is argued that this provides strong observational evidence for the presence of energy losses in the propagation process; and for the exclusion of low-energy galactic nuclei from near Earth. (auth)

8889 NONLINEAR DISSIPATION OF ALFVEN WAVES. Chin, Y. C.; Wentzel, D. G. (Univ. of Maryland, College Park). Astrophys. Space Sci.; 16: No. 3, 465-477(Jun 1972).

Alfvén waves are generated easily in many cosmic plasmas, but they possess no linear damping mechanism since they are not compressive. The most prominent nonlinear damping occurs when one Alfvén wave decays into another plus a slow magnetosonic wave, or two Alfvén waves combine into one fast magnetosonic wave; the resulting magnetosonic waves can then be dissipated. The nonlinear coupling rates are presented, with special emphasis on the astrophysically important case of sound speed ≪Alfvén speed. Streaming cosmic rays generate Alfvén waves moving in the direction of streaming, but they reabsorb the backward moving waves then produced by wave decay. The possible steady states for this system of cosmic rays and Alfvén waves turn out to be highly restricted. (auth)

8890 FURTHER EVIDENCE FOR A COSMIC-RAY SELECTION MECHANISM. Kristiansson, K. (Univ. of Lund, Sweden). Astrophys. Space Sci.; 16: No. 3, 405-412(Jun 1972).

A comparison is made between the overabundance of heavy elements in the primordial cosmic radiation and the cross section for ionization by charged particle impacts. It is found that there is evidence that this type of ionization is important for the selection of cosmic-ray particles. (auth)

8891 RADIAL GRADIENTS AND ANISOTROPIES DUE TO GALACTIC COSMIC RAYS. Urch, I. H.; Gleeson, L. J. (Monash Univ., Australia). Astrophys. Space Sci.; 16: No. 1, 55-74(Apr 1972).

Numerical calculations were made of the radial gradients and the anisotropy vector at r = 1 AU due to galactic cosmic-ray protons and helium nuclei. The model used assumed transport by convection and anisotropic diffusion, and included the energy losses due to adiabatic deceleration. The calculations were for the 1964–65 solar minimum. An important constraint applied in each case was that the model reproduces the electron modulation known from deductions of the galactic spectrum and observations of the near-Earth spectrum; and also reproduces the near-Earth proton and helium nuclei spectra. The diffusion coefficients were based upon those deduced from magnetic-field power spectra. The principal aim was to provide estimates of radial gradients and anisotropies, particularly at kinetic energies $T \gtrsim 100$ MeV/N, by the complete solution of realistic models. Typical values for protons, obtained with a galactic differential number density $\propto$ (total energy)$^{-2.5}$, at $T \leq 50$ MeV were: radial gradient, 25%/AU; radial anisotropy; −0.2%; azimuthal anisotropy, ~0.2%. These values changed markedly when the galactic spectrum was cut-off or greatly enhanced at T < 150 MeV, but the intensity spectrum near Earth remained substantially unchanged. It is shown that it is possible to obtain negative radial gradients and positive radial anisotropies at $T \gtrsim 50$ MeV for galactic particles and thus to mimic solar sources. The radial gradient for 1964–65 reported by Anderson (1968) and by Krimigis and Venkatesan (1969) are shown to be consistent with the diffusion coefficient deduced from the magnetic-field power spectrum; those reported by O'Gallagher are higher than expected and that for $20 \leq T \leq 30$ MeV protons appears to be inconsistent. More precise data on conditions throughout the solar cavity are required if more definitive gradients and anisotropies are to be determined. (auth)

8892 COSMIC-RAY PRODUCTION OF DEUTERIUM, ^{3}He, LITHIUM, BERYLLIUM, AND BORON IN THE GALAXY. Mitler, H. E. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. Space Sci.; 17: No. 1, 186-218(Jul 1972).

The production of deuterium, ^{3}He, lithium, beryllium, and boron by galactic cosmic rays in the interstellar medium, over the life of the Galaxy, is calculated. It is found that high-energy $\alpha-\alpha$ reactions contribute in an essential way to the observed lithium. When allowance is made for the interchange of material between stars and the interstellar gas and for the change of cosmic-ray intensity with time, the ^{6}Li, ^{9}Be, and boron produced turn out to be ample to explain the observed abundances, and with remarkable internal consistency. Deuterium and ^{3}He are not produced in significant amounts, nor ^{7}Li in sufficient amount, however. To explain the ^{7}Li/^{6}Li ratio measured terrestrially and in chondritic meteorites, cosmological production of ^{7}Li is invoked. This implies the production of deuterium, ^{3}He, and ^{4}He as well, in amounts consistent with observation. The theory in its present form cannot explain a solar-system ^{7}Li/^{6}Li ratio of 12 and stellar ratios as low as 3, but additional processes can be adduced to reconcile them. The consistency of the numbers when cosmological production is included lends additional support to the big-bang hypothesis. An incidental result is that the mean luminosity of the Galaxy over its lifetime has been about 3 times its present luminosity. (auth)

8893 OBSERVATION OF COSMIC-RAY NEUTRON INTENSITY AT MORIOKA. 2. Barometric Pressure Effect. Chiba, T. (Iwate Univ., Morioka, Japan). Iwate Daigaku Kyoikugakubu Kenkyu Nenpo; 31: 25-29(1971).

Barometric pressure effect on cosmic-ray neutron intensity is discussed and its barometric coefficient. β, is evaluated by using the data from the IGY type neutron monitor given in Part 1. The result shows that $\beta = -0.689 \pm 0.022$ %/mb at Morioka. It is concluded that this value of β is plausible in comparison with other data of the barometric pressure effect. (auth)

8894 PROPAGATION VELOCITY OF SHOCK WAVES CAUSING GEOMAGNETIC STORMS AND FORBUSH DECREASES. Kuz'micheva, A. E.; Dorman, L. I.; Kaminer, N. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 794-796(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 918-919(1972).

The results of a study of the propagation velocity of shock waves, determined from the time lag Δt of the commencement of a magnetic storm and associated Forbush decrease relative to a chromospheric flare, are discussed. (WDM)

8895 BAROMETRIC COEFFICIENTS OF THE NUCLEON COMPONENT OF COSMIC RAYS OF DIFFERENT ENERGIES. Blokh, Ya. L.; Eroshenko, E. A.; Kapustin, I. N.; Radkevich, V. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 798-799(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 922-923(1972).

To study the energy dependence of the barometric coefficient, the intensity of the neutron component of cosmic rays with different dead times was measured. The data were used to calculate the ratios of barometric coefficients for different multiplicities of a standard multiplicity recorder β_m and a multiplicity recorder with automatic application of corrections for the coincidence effect β_m. The results confirm the conclusions reached by Kapustin and Radkevich (1969). (WDM)

8896 TIME AND SPACE VARIATIONS OF COSMIC-RAY INTENSITY INCREASES PRIOR TO FORBUSH DECREASES. Kaminer, N. S.; Kuz'micheva, A. E.; Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 707-714(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 814-822(1972).

The dependence on local time of cosmic-ray intensity increases prior to Forbush effects is investigated for various instants of time preceding the beginning of a Forbush effect. Use of the ring of stations method made it possible to obtain the longitudinal distribution of the increase effect. It is demonstrated that an agreement between experimental data and theoretically expected values is obtained on the assumption that the Forbush decrease and its preceding intensity increase are produced by a shock wave appearing at a considerable distance from the Sun. The shape of the shock wave front is determined. (auth)

8897 RAZIN–TSYTOVICH EFFECT FOR BREMSSTRAHLUNG. Melrose, D. B. (Australian National Univ., Canberra). Astrophys. Space Sci.; 18: No. 2, 267-272(Oct 1972).

It is shown that bremsstrahlung from electrons with Lorentz factor $\gamma \gg 1$ is suppressed for $\omega < \gamma\omega_p$ in a plasma with plasma frequency ω_p compared with emission in vacuo. For $\omega \ll \gamma\omega_p$ the ratio of the power emitted per unit frequency in the plasma to that in vacuo varies as ω^2. This suppression effect is analogous to the

suppression of synchrotron radiation in a plasma (Razin–Tsytovich effect). It is argued that such suppression is a characteristic property of emission by relativistic particles in a plasma. (auth)

8898 PULSED GALACTIC NUCLEI AND THE ORIGIN OF COSMIC RAYS. Wayland, J. R. (Texas A and M Univ., College Station). Astrophys. Space Sci.; 18: No. 1, 89-93(Sep 1972).

The possibility that a series of explosions of the galactic nuclei every 5×10^8 yr can cause a substantial flux of cosmic-ray particles at the vicinity of the Earth is investigated. The steady flux of cosmic radiation forces the conclusion that there have been explosions back to 10^9 yr if this is a dominant source of cosmic rays. (auth)

8899 DIFFUSE COSMIC GAMMA RAYS OBSERVED AT AN EQUATORIAL BALLOON ALTITUDE. Daniel, R. R.; Joseph, G.; Lavakare, P. J. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 18: No. 2, 462-467(Oct 1972).

A 3″ × 3″ NaI(Tl) crystal-photomultiplier assembly with a 4π charged particle anti-coincidence shield was used to determine the gamma-ray spectrum in the energy region of about 100 keV to 8.5 MeV at a balloon altitude of 4.7 g cm^{-3} over Hyderabad, India (geomagnetic latitude ~8°N). The atmospheric growth curves were used to obtain the contribution of the diffuse cosmic gamma-ray flux in the above energy range. The cosmic photon flux thus deduced up to about 8.5 MeV was consistent with a continuation of the power law spectrum observed at energies between 20 and 200 keV with an index of ~−2.3, and hence contradicted the flattening trend observed in ERS-18 at an energy of a few MeV. (auth)

8900 SECONDARY PRODUCTION OF GALACTIC COSMIC-RAY ELECTRONS. Choate, L. M.; Wayland, J. R. (Texas A and M Univ., College Station). Astrophys. Space Sci.; 19: No. 1, 195–200(Nov 1972).

The differential energy spectrum and charge ratio of primary cosmic ray electrons produced by collisions of primary cosmic ray particles with the interstellar medium are calculated by means of the two temperature statistical model of high-energy interactions. Two realistic models for the primary cosmic ray flux are considered. Contributions to the primary cosmic ray electron intensity from both the pion and kaon decay modes have been included. The distribution of matter in the Galaxy and energy loss of produced secondaries and electrons are considered. The results are compared to recent experimental data. (auth)

8901 PATH LENGTH DISTRIBUTION OF COSMIC RAYS FROM PULSAR NEBULA COMPLEXES. Aparao, K. M. V.; Rengarajan, T. N. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 19: No. 1, 293–296(Dec 1972).

Particles accelerated in the vicinity of pulsars have to traverse the nebular matter surrounding pulsars. Using the variation of pulsar luminosity and nebular expansion, the path length distribution for the particle radiation is deduced and compared with that obtained from experimental observation. It is found that a significant amount of matter traversed by cosmic rays can be in the source itself; but it is not possible to simultaneously account for the production of secondary electrons and secondary nuclei with the same set of parameters. (auth)

8902 SHAPE OF THE DIFFUSE COSMIC X-RAY SPECTRUM. Dyer, C. S.; Engel, A. R.; Quenby, J. J. (Imperial Coll. of Science and Tech., London). Astrophys. Space Sci.; 19: No. 2, 359-367(Dec 1972).

Recent work by Dyer and Morfill has shown that satellite measurements of the diffuse cosmic x-ray spectrum made with crystal scintillators may include errors due to radioactive spallation products formed in the detector by inner belt and cosmic-ray protons. An estimate is made of the magnitude of this source of background for the various experimental situations and it is shown that apparent features at 40 keV and 1 MeV are likely to be due to radioactive decays in the instruments. A review is made of experiments covering the range 1 keV to 100 MeV in order to ascertain whether a single exponent spectrum is capable of fitting the experimental results. The astrophysical implications of such a spectrum are briefly considered. Suggestions are made for the location and correction for background of future experiments. (auth)

8903 COLLIMATOR CORRECTIONS TO THE MEASURED DIFFUSE X RAY BACKGROUND. Dumas, A.; Horstman, H.; Horstman Moretti, E. (CNR, Bologna). Astrophys. Space Sci.; 19: No. 2, 495-500(Dec 1972).

The contribution to the main detector counting rate from photons scattered and reemitted from the collimator walls is considered in two particular cases, that of the old S-11 rocket data and OSO-III. It is found that the S-11 results are not changed appreciably while consideration of the OSO-III results has led to the belief that these results should be strongly modified. (auth)

8904 SURVEY ON THE RECENT MEASUREMENTS OF THE ABSOLUTE VERTICAL COSMIC-RAY MUON FLUX AT SEA LEVEL. Allkofer, O. C.; Jokisch, H. (Univ., Kiel). Nuovo Cim.; 15A: 371-389(1 Jun 1973).

A comparison of recent measurements of the absolute vertical intensities of muons in the momentum range (0.2 to 10) GeV/c is presented. The results are consistent—within an error of 8%—with a form spectrum normalized at the standard momentum of 1 GeV/c to the value of $3.09 \cdot 10^{-3}$ cm^{-2} sr^{-1} s^{-1} (GeV/c)$^{-1}$. All parameters having influence on the accuracy of absolute measurements are discussed. (auth)

8905 SHORT-LIVED NON-PERIODICAL CHANGES IN NEUTRON COMPONENT INTENSITY OF COSMIC RADIATION DURING THE TRANSITION PERIOD FROM "CALM" TO "ACTIVE" SUN. Akhababyan, N.; Kirov, I. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 99-104(1972). (In Russian).

On the basis of two-year continuous intensity measures of the neutron component of cosmic sun, produced in cosmic station on Moussala peak the relation between the intensity changes of studied component and the disturbances in earth's magnetic field, the manifested magnetic storms and sun-spots, was examined. It was found that the average day correlation among them exists only in days with magnetic storms. The amplitude of the manifested Forbuch-reductions increases with the size augmentation of these storms, while the correlation with the sun-spots number is manifested only in the cases of "great" magnetic storms, which evidently is handed by means of the influence of sun-spots on the state of earth magnetic field. (auth)

8906 STATISTICAL ANALYSIS OF CONTINUOUS INTENSITY MEASURES OF THE COSMIC RADIATION NEUTRON COMPONENT. Akhbabyan, N.; Krysteva, S. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 105-117(1972). (In Russian).

The data from continuous registration of neutron component intensity of the cosmic radiation, carried out on the cosmic station in Moussala peak were submitted to a detailed statistical analysis. The type and the standard deviations of the distribution of the different series of measures were determined, as average daily intensities, two-hours values, differences between the adjacent values, etc. The investigation is made both for the uncorrected data of the meteorological influences and for the corrected intensities for barometrical effect. These parameters are determined for comparison of different periods from measures, as well as according to data of other stations for registration. It was found that while the distribution of the uncorrected average daily and two-hour deviations for meteorological influences from the average value for the period is not normal, the distribution of all other series of measures is normal. Moreover always the standard deviation surpasses several times the apparatuses' statistical precision. On the other hand, disorders of apparatuses' origin reflect noticeably on the type of data distribution. The results obtained can be used for preparation of algorithms for automatic processing of primary data from continuous intensity measures of cosmic radiation neutron component. (auth)

Stars

Refer also to abstracts 8980, 9071, 9573, and 9804.

8907 (AD-753898) INFRARED STARS WITH STRONG 1665 TO 1667-MHz OH MICROWAVE EMISSION. Report for June 1969–September 1971. Wilson, W. J. (Aerospace Corp., El Segundo, Calif.). 30 Nov 1972. Contract F04701-72-C-0073. 42p. (SAMSO-TR-72-290). NTIS.

Microwave and infrared observations are presented of seven stars that have strong infrared and 1665/1667-MHz main-line OH emission. The sources were selected because the 1665/1667-MHz OH emission is stronger than the 1612-MHz OH emission. Five of these sources have associated H_2O microwave emission. The sources are associated with M-type, long-period variable stars and generally show only a small, excess infrared radiation from 3 to 20 micrometers above that expected from the photosphere. The data indicate that both 1665/1667-MHz and 1612-MHz stars form a continuous sequence in their intrinsic OH luminosities and their infrared properties. (auth) (NTIS)

8908 (AD-755902) POST EVENT NEUTRON EXPOSURE OF R PROCESS MATERIAL. Blake, J. B.; Schramm, D. N. (Aerospace Corp., El Segundo, Calif.). 30 Jan 1973. Contract F04701-72-C-0073. 46p. (SAMSO-TR-73-19). NTIS.

The effects of neutron fluxes on r-process material following the r-process event are considered. The calculations examine the case of neutron exposure occurring after the r-process material has decayed back to or near the valley of beta stability. Such exposure may occur during the r-process freeze-out or in some

other subsequent neutron exposure. Limitations on these neutron fluxes are inferred from odd–even effects in the A about 130 and A about 195 r-process peaks and from the abundances of certain s-only nuclei. The effects of these neutron fluxes on the abundances of lead, bismuth, and the nucleochronologically important actinides are examined. (auth) (NTIS)

8909 (LA-UR-73-489) EXPLOSIVE CARBON BURNING. Howard, W. M. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 10p. (CONF-730415-1). Dep. NTIS $3.00.

From conference on explosive nucleosynthesis; Austin, Texas, USA (2 Apr 1973).

The effects of explosive carbon burning are far reaching in producing many of the observed nuclei in the solar system; however, the results depend upon many nuclear and hydrodynamical details. A consistent theory of explosive carbon burning that produces the Mg isotopes as well as the rare neutron-rich nuclei in their proper solar system abundance ratios will place severe constraints on allowable supernova explosions. Tables of important nuclear reactions and overproduction factors for various isotopes are given. (WDM)

8910 (N-73-16814) STELLAR EVOLUTION OF HIGH MASS BASED ON THE LEDOUX CRITERION FOR CONVECTION. Stothers, R.; Chin, C. (National Aeronautics and Space Administration, New York. Goddard Inst. for Space Studies). [1972]. 42p. (NASA-TM-X-68914). NTIS.

Theoretical evolutionary sequences of models for stars of 15 and 30 solar masses were computed from the zero-age main sequence to the end of core helium burning. During the earliest stages of core helium depletion, the envelope rapidly expands into the red-supergiant configuration. At 15 solar mass, a blue loop on the H–R diagram ensues if the initial metals abundance, initial helium abundance, or $^{12}C-\alpha$ reaction rate is sufficiently large, or if the $3-\alpha$ reaction rate is sufficiently small. These quantities affect the opacity of the base of the outer convection zone, the mass of the core, and the thermal properties of the core. The blue loop occurs abruptly and fully developed when the critical value of any of these quantities is exceeded, and the effective temperature range and fraction of the lifetime of core helium burning during the slow phase of the blue loop vary surprisingly little. At 30 solar mass no blue loop occurs for any reasonable set of input parameters. (auth) (STAR)

8911 MODELS OF CORE-HELIUM-BURNING STARS. Castellani, V. (Univ., Rome); Giannone, P.; Renzini, A. Astrophys. Space Sci.; 17: No. 1, 80-86(Jul 1972).

Some aspects concerning the core-mass increase and the appearance and development of an intermediate semiconvective zone in helium-burning stars are discussed. An iterative method of computation of core increase and semiconvection is also presented. Details of this procedure are given with regard to the horizontal-branch stars of globular clusters. (auth)

8912 RADIAL DISPLACEMENTS OF DIFFERENT ELEMENTS IN α^2 CVn. Renson, P. (Univ., Liege). Astrophys. Space Sci.; 17: No. 1, 69-79(Jul 1972). (In French).

Curves of radial displacements for α^2 CVn were obtained by mechanical integration of radial velocity curves deduced from measures by Struve and Swings and by Babcock and Burd for EuII, CrII, FeI and II, and by Pyper for EuII. In order to proceed to the comparison, a value as accurate as possible was sought for the period (5.4693 ± 0.0001 d). Small differences between the curves for a given ion were noted, especially when using Pyper's measures. However these discrepancies did not necessarily prove the existence of secular variations; in the binary model, they can be interpreted mainly in terms of the Ovenden effect. Too large displacements, and other peculiarities in the variations, may also be attributed to that effect, and to circumstellar currents. The ranges of the velocity variations and of the radial displacements are also discussed for other Ap stars. (auth)

8913 STRUCTURE OF THE GLOBULAR CLUSTER M4. Castellani, V.; D'Antona, F. A.; Natta, A. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Astrophys. Space Sci.; 17: No. 1, 23-29(Jul 1972).

On the basis of the work by Greenstein on the globular cluster M4, the spatial distribution for groups of cluster stars in different stages of evolution is investigated. The comparison between the various samples is made using the apparent distributions. The results are discussed. (auth)

8914 HYDROGEN FLASH IN STARS. Perri, F.; Cameron, A. G. W. (Yeshiva Univ., New York). Nature (London); 242: No. 5397, 395-396(6 Apr 1973).

A discussion is presented regarding the way in which a star approaches the main sequence. It is thought possible that the ignition of hydrogen burning reactions at the center of the star can be accompanied by a thermal runaway resulting in expansion of the star and formation of a body in hydrostatic equilibrium, somewhat on the low temperature side of the main sequence. There would be a rapid rise in luminosity and this process might explain the sudden flare-up of the star FU Orionis. The process might also account for hitherto puzzling features of the Hertzsprung–Russell diagrams of young clusters, the hydrogen flash process then placing resulting stars quite close to the main sequence. (UK)

8915 TIDAL EVOLUTION IN CLOSE BINARY SYSTEMS. Kopal, Z. (Lunar Science Inst., Houston, TX). Astrophys. Space Sci.; 17: No. 1, 161-185(Jul 1972).

A mathematical outline is given of the theory of tidal evolution in close binary systems of secularly constant total momentum — an evolution activated by viscous friction of dynamical tides raised by the two components on each other. A general outline of the problem is presented and the basic expressions for the energy and momenta of close binaries consisting of components of arbitrary internal structure are established. The maximum and minimum values of the energy (kinetic and potential) which such systems can attain for given amount of total momentum are investigated. The results are compared with the actual facts encountered in binaries with components whose internal structure (and, therefore, rotational momenta) are known from evidence furnished by the observed rates of apsidal advance. (WDM)

8916 MASS-LUMINOSITY RELATION. McCluskey, G. E., Jr. (Lehigh Univ., Bethlehem, PA); Kondo, Y. Astrophys. Space Sci.; 17: No. 1, 134-149(Jul 1972).

The results of a least-squares study of the mass–luminosity relation for eclipsing and visual binary stars consisting of main sequence components are presented. Two methods are discussed. In Part A, the values of the coefficients A and B in the relation $\log M = A + BM_{BOL}$ are determined. Part B presents a technique which permits the determination of α and β in the relation $M = \alpha L^{\beta}$, when only the sum of the masses, and not the individual masses of each component, is known. The results and a comparison of the two methods are discussed. It is found that the following mass–luminosity relation represents the observational data satisfactorily: $\log M = 0.504 - 0.103M_{BOL}$, $-8 \leq M_{BOL} \leq +10.5$. A discussion of the data and of the possibility that separate mass–luminosity relations may exist for visual and eclipsing binaries is given. The possibility that more than one mass–luminosity relation is required in the range $-8 \leq M_{BOL} \leq +13$ is also discussed. (auth)

8917 PULSED AND CONTINUOUS RADIATION FROM WHITE DWARFS. Lerche, I. (Univ. of Chicago). Astrophys. Space Sci.; 17: No. 1, 117-125(Jul 1972).

It is demonstrated that the detection of steady kV x-ray emission from the vicinity of a white-dwarf star possessing a magnetic field of the order of 10^7 G will provide strong evidence that the white dwarf is rotating with a period of about one minute. It is also shown that detection of pulsed radiation at about 1 mm wavelength would confirm this. Also some of the interesting dynamical consequences for the interstellar medium due to such white dwarfs are outlined. (auth)

8918 STRUCTURE OF CLOSE BINARIES. II. THEORY OF UNIFORMLY ROTATING BINARIES. Naylor, M. D. T.; Anand, S. P. S. (Univ. of Toronto). Astrophys. Space Sci.; 16: No. 1, 137-150(Apr 1972).

The stellar structure equations for uniformly rotating, synchronous close binaries were derived using a modified double approximation technique which has been successful in studies of rotating stars and close binary polytropes. The auxiliary functions which are necessary to obtain interior models were derived and their numerical values are given for various mass ratios. In order to calculate the apparent luminosities and colors of binary models the effects of gravity darkening (either radiative or convective) must be taken into account. Tables are presented for different degrees of distortion, mass ratio, and the two extremes of inclination which allow the apparent luminosity and mean effective temperature to be determined if the interior luminosity and separation of the components are given. (auth)

8919 HIGHLY EXCITED HYDROGEN LINES IN STELLAR SPECTRA. II. Barcza, S. (Konkoly Observatory, Budapest). Astrophys. Space Sci.; 16: No. 3, 372-385(Jun 1972).

The shifts of the last visible Balmer lines as a function of the gas density are predicted theoretically. Spectroscopic research for these shifts is reported: 10 A/mm^{-1} spectra of six stars were examined and published material of other authors was also

used. The shifts are of tenth Angström order of magnitude and they are used to measure the gas density in a well defined region of the stellar atmosphere. It is shown that usually there is no real coalescence of Balmer lines. The lack of Balmer lines with high main quantum number is explained adequately in most cases without Stark and Doppler effect. Evidence is given against using the Inglis–Teller formula because its physical foundation is inadequate. It gives false values in general. Stars with peculiar spectra — helium and carbon Wolf-Rayet stars — are briefly mentioned as well because the last visible Balmer-like line of HeI or CIV gives a density value in their atmospheres which is a useful first guess in understanding their spectra better. (auth)

8920 PERTURBATION OF THE RADIAL AND NONRADIAL OSCILLATIONS OF A STAR BY A MAGNETIC FIELD. Goossens, M. (Univ., Louvain, Belgium). Astrophys. Space Sci.; 16: No. 3, 386-404(Jun 1972).

A generalization of the perturbation method is applied to the problem of the radial and nonradial oscillations of a gaseous star which is distorted by a magnetic field. An expression is derived for the perturbation of the oscillation frequencies due to the presence of a weak magnetic field when the equilibrium configuration is a spheroid. The particular application to the homogeneous model with a purely poloidal field inside, due to a current distribution proportional to the distance from the axis of symmetry, and a dipole type field outside is considered in detail. The main result is that the magnetic field has a large and almost stabilizing effect on unstable g-modes, particularly on higher order modes. With the considered magnetic field the surface layers appear to have a large weight. (auth)

8921 THERMAL WAVES IN STARS. Klimishin, I. A. (Lvov State Univ.). Astrophys. Space Sci.; 16: No. 3, 432–436(Jun 1972).

It is shown by a certain combination of stellar parameters and energy which was released by an outburst, the transfer of that energy outwards is carried out by the thermal wave. (auth)

8922 INTERPRETATION OF THE PHOTOMETRY OF IRREGULAR VARIABLE STARS OBSERVED INTERMITTENTLY. Fellgett, P. (Univ. of Reading, Eng.). Astrophys. Space Sci.; 16: No. 3, 437–444(Jun 1972).

The inherent possibilities and limitations in the characterization of irregular variables are considered when, as is almost inevitably the case, the observations are not effectively continuous. The historical tendency to interpret almost everything in terms of strict periodicity is criticized. The basic logic of the situation is discussed, and it is emphasized that intermittency of observation inevitably blunts the knowledge of the spectrum of the variation. This can be restored to only a limited extent, depending on how reliably it is possible to presume missing observations by interpolation. Some application is made to a recent publication on 3C 345. A knowledge of formal Fourier theory is assumed, and the aim is to discuss critical principles rather than to recommend any fixed procedures of interpretation. (auth)

8923 PULSATION AMPLITUDE OF CEPHEID VARIABLES. Nikolov, N.; Tsvetkov, T. (Univ., Sofia). Astrophys. Space Sci.; 16: No. 3, 445–450(Jun 1972).

On the basis of more abundant data a relation $\log P\,\Delta V/\log \Delta R$ for Cepheid variables (Fernie, 1965) is constructed. A linear relation between $\log P\,\Delta V$ and $\log \Delta R$ for classical Cepheids is found, which perhaps has a break at $\Delta R = 10R_\odot$. On the $\log \Delta R/\log P$ diagram the s-Cepheids (Efremov, 1968) show a distinct sequence. All s-Cepheids present a relative variation of the radii $\Delta R/R \leq 0.075$. The existence of non-s-Cepheids with $\Delta R/R \leq 0.075$ raises a point about the evolutionary place of these stars (Efremov, 1968). One could suppose that Cepheids with $\log P > 1.1$ pulsate in the first overtone. (auth)

8924 OSCILLATIONS OF POLYTROPE WITH A TOROIDAL MAGNETIC FIELD. Sood, N. K. (Panjab Univ., Chandigarh, India); Trehan, S. K. Astrophys. Space Sci.; 16: No. 3, 451–464(Jun 1972).

The radial and the nonradial (l = 2) modes of oscillation of a gaseous polytrope with a toroidal magnetic field are examined using a variational principle. It is found that the frequencies of oscillation of the radial mode and the Kelvin mode (l = 2) decrease due to the presence of the magnetic field. The shift in the frequency of the Kelvin mode may be split up into two parts, viz. the shift in frequency due to the magnetic field on the unperturbed sphere [$(\sigma_1^2)_M$, say] and the shift in frequency due to the distortion of the structure by the magnetic field [$(\sigma_1^2)_S$, say]. In the first order calculations using one parameter trial function, it is found that $(\sigma_1^2)_M$ is indeed positive but is overweighed by a negative $(\sigma_1^2)_S$. In the second order calculations using a trial function with two variational parameters, it is found that the general behavior of $(\sigma_1^2)_M$ and $(\sigma_1^2)_S$ is unchanged but that $(\sigma_1^2)_M$ becomes negative for polytropic indices $n \geq 1.5$. The effect of a small rotation and toroidal magnetic field on the structure of a polytrope is studied. It is found that the resulting configuration is a prolate spheroid, a sphere or an oblate spheroid according as $T \gtrless qM$, respectively. Here M denotes the magnetic energy and T the kinetic energy due to rotation and q is a constant which depends on the polytropic index n. The values of q are given. (auth)

8925 RESULTS OF THE COOPERATIVE PHOTOMETRIC OBSERVATIONS OF THE UV CET TYPE FLARE STARS IN THE YEARS 1967 TO 1971. Gershberg, R. E. (Crimean Astrophysical Observatory, Nauchny, USSR). Astrophys. Space Sci.; 19: No. 1, 75-92(Nov 1972).

The list of the cooperative photometric observations of the UV Cet-type flare stars that were organized during the years 1967 to 1971 by the Working Group on Flare Stars of the IAU Commission 27 is given. The completeness and reliability of the data obtained were evaluated by comparing simultaneous observations at different observatories. The statistical analysis of the UV Cet, YZ CMi, EV Lac, and AD Leo flares observed in the B-band was carried out. The flare energy spectrum in the energy range where observational selection effects were small was found to be $d \ln \nu/d \ln E_B = -1.4$ to -1.9 ν was an occurrence of flares with radiation energy of E_B. The total flares' radiation was equal to 1.7, 1.2, 0.3, and 0.4% of the quiet radiation in the B-band of the stars listed, and the main part of this total radiation was due to the strongest flares. Distributions of flare rise times (t_r) and of rates of flare absolute luminosity increase ($d^2E_B/dt_r^2 \equiv \ddot{E}_r$) were considered; these parameters of flare were independent statistically for all stars studied. Correlation coefficients $r(E_B, t_r)$ and $r(E_B, \ddot{E}_r)$ were rather small except $r(E_B, t_r) = 0.86$ for the AD Leo flares. Contradictory conclusions on temporal distribution of flares infered by different investigators were noted. (auth)

8926 FORMATION OF DOUBLE STARS. Kumar, S. S. (Univ. of Virginia, Charlottesville). Astrophys. Space Sci.; 17: No. 2, 453–458(Aug 1972).

From a calculation of Roche densities in visual binaries, it is concluded that the stars in these systems would be tidally unstable at the time of formation if they were formed with their observed separations (semi-major axes). To avoid this difficulty, it is proposed that the visual binaries are formed by the disintegration of small clusters. Binaries formed this way are shown to have some interesting upper limits to their mass ratios. Comments are also made on the differences between the processes of star and planet formation. (auth)

8927 POLYTROPIC SUBSONIC STELLAR WINDS WITH MAGNETIC FIELDS. Durney, B. (National Center for Atmospheric Research, Boulder, CO). Astrophys. Space Sci.; 17: No. 2, 489–498(Aug 1972).

In any complex magnetic field configuration it is to be expected that there will be not only regions of no flow (closed magnetic field lines) and of supersonic flow, but also regions of subsonic flow. Subsonic stellar winds could also be of importance in stars of different type than the Sun. The equations for the stellar wind are examined in the case of a polytropic relation between pressure and density and for small values of the parameter $\epsilon = \Omega^2 r_a^2/u_a^2$. The radial distance (r) and the velocity at the Alfvénic point ($4\pi\varrho u^2/B^2 = 1$) are denoted by r_a and u_a, and Ω is the angular velocity. It is shown that: solar breeze solutions (that is, solutions that are subsonic for values of r such that $r \gg r_a$) exist only if the dimensionless energy flux is larger than $\frac{3}{2}\epsilon^{\frac{1}{2}}$. If $\epsilon \to 0$ the flow with magnetic field tends to the flow without magnetic field for $r < R$ ($R \to \infty$ as $\epsilon \to 0$). For $r \to \infty$ the velocity tends always to a finite value; this does not introduce, however, a singularity in the equations. (auth)

8928 SCATTERING OF WAVES IN A MAGNETOACTIVE PLASMA. Melrose, D. B.; Sy, W. (Australian National Univ., Canberra). Astrophys. Space Sci.; 17: No. 2, 343–356(Aug 1972).

A general theory of scattering of waves in a magnetoactive plasma by particles of arbitrary energy is presented. The cross section for the scattering of magnetoionic waves by thermal particles is derived and discussed. Conditions under which the effect of the spiralling motion of the scattering electron can be neglected in treating inverse Compton radiation are found. (auth)

8929 LUMINOSITY AND MASS FUNCTIONS FOR LOW MAIN-SEQUENCE STARS. Mazzitelli, I. (Laboratorio di Strofiscia Spaziale, Frascati, Italy). Astrophys. Space Sci.; 17: No. 2, 378–389(Aug 1972).

The luminosity function derived for main-sequence stars in the neighborhood of the Sun shows evidence for a flattening in the interval $5 \lesssim M_v \lesssim 8$. An interpretation of this feature by means of

theoretical models enables one to deduce the mass function for stars belonging to the main sequence. (auth)

8930 STATISTICS ON THE SOLAR SPECTRUM SUITABLE FOR THE STUDY OF THE BLANKETING EFFECT IN STARS OF SPECTRAL TYPES F, G, AND K. Natta, A.; Ranieri, M. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Astrophys. Space Sci.; 17: No. 2, 390-408(Aug 1972).

A complete set of statistics useful to the study of the blanketing effect in stars of spectral type F, G, and K were obtained on the basis of the solar spectrum. In the spectral range 2250 to 6400 Å the following distributions were derived: distribution of lines with chemical elements, percentage of lines originating from ionized atoms, distribution of lines with the excitation potential and with the oscillator strength. Also the distribution with the equivalent width was obtained in the range 3060 to 6400 Å. With these distributions, samples of lines were derived for intervals of about 200 Å in the range 2250 to 6400 Å. Evaluations for the spectral density of lines and the percentage of nonoverlapping lines were also included. (auth)

8931 SELF-ACCRETION OF MATTER, RED SUBLUMINOUS STARS, AND EARLY EVOLUTION OF LOW-MASS STARS. Castellani, V. (Univ., Rome); Panagia, N. Astrophys. Space Sci.; 15: No. 3, 462-466(Mar 1972).

Low-mass stars during their pre-main sequence contraction phase are expected to be surrounded by a certain amount of the primordial gas. At low luminosities, accretion of this gas can make the stars to follow a peculiar evolutionary course which can account for certain types of red subluminous stars. The efficiency of the accretion mechanism can also account for some peculiarities in the spectra of the stars of low mass. (auth)

8932 EQUILIBRIUM AND STABILITY OF UNIFORMLY ROTATING GASEOUS SYSTEMS IN HYDROMAGNETICS. I. Mathematical Techniques. Anand, S. P. S. (Univ. of Toronto). Astrophys. Space Sci.; 15: No. 3, 415-425(Mar 1972).

The theory for investigating the equilibrium and stability of a uniformly rotating gaseous system with a prevalent magnetic field is developed by using the virial tensor approach. Most of the discussion depends on the assumption that on the surface of the system, the magnetic field is zero. However, the case in which the surface magnetic field is nonzero is considered. The nine modes of oscillations, grouped into the transverse shear, toroidal, and pulsation modes are obtained. From this analysis the conditions under which the sequence of a uniformly rotating axially symmetric configuration in the presence of a magnetic field should have a point of bifurcation are found, that is, a point where objects with genuine triplanar symmetry branch off. This condition is also generalized to include the effects of differential rotation and nonzero surface magnetic field. Applications to the cosmogonic fission problem, the study of the pulsation of rotating magnetic stars and some radio astrophysical problems are briefly discussed. (auth)

8933 EVOLUTION OF MASSIVE STARS WITH MASS LOSS. Bisnovatyi-Kogan, G. S.; Nadyozhin, D. K. (Inst. of Applied Mathematics, Moscow). Astrophys. Space Sci.; 15: No. 3, 353-374(Mar 1972).

The evolution of massive stars was investigated in the phases of hydrogen and helium burning, taking into account the mass-loss due to light pressure in optically thick media. The evolution in the stage of hydrogen burning near the main sequence occurs without mass loss. The large inverse density gradient appears in the outer layers of a 30 $M_\odot$ star after it goes into the domain of red supergiants in the helium-burning stage. This effect appears as a consequence of an excess of luminosity of the star the critical one in sufficiently extensive outer layer, where convection is not so effective. In this way, the conditions for outflow of matter are formed. The sequence of selfconsistent models is constructed, with the core in hydrostatic equilibrium and hydrodynamically outflowing envelope. The amount of mass loss is not a given parameter, but it is found during the calculations as a characteristic number of the problem. The amount of mass loss is very high, of the order of $\sim 0.5\ M_\odot$ yr, the velocity of the flow is ~ 20 km s^{-1}. The star loses about 7.2 $M_\odot$ during 15 yr. The amount of mass loss must rapidly decrease or finish altogether when matter near the hydrogen-burning layer begins to flow out, and a transformation of stellar structure must occur. The evolution of a 9 $M_\odot$ star is calculated. The density in the envelope of this star is sufficiently large and the outer convective zone, which develops on the red giant stage, prevents the outflow of matter. The intensive mass outflow from such star can take place during carbon burning, or heavier element burning stages. The formation of infrared stars and Wolf–Rayet stars can possibly be explained by such a mechanism of mass loss, so that the infrared stage must precede the Wolf–Rayet stage. (auth)

8934 TRANSFER OF RESONANCE RADIATION AND PHOTON RANDOM WALKS. Ivanov, V. V. (Leningrad State Univ.); Sabashvili, Sh. A. Astrophys. Space. Sci.; 17: No. 1, 13-22(Jul 1972).

Transfer of resonance radiation in an infinite medium is considered as a process of random walks of photons. Close relation is shown to exist between the problems of transfer of line radiation and the stable distributions of the probability theory. This relation is used as a basis of a new method for the investigation of the asymptotic properties of the radiation field far from the sources. (auth)

8935 MWC 645 AND MWC 819: TWO STARS RESEMBLING ETA CARINAE. Swings, J. P. (Institut d'Astrophysique, Cointe-Ougree, Belgium); Allen, D. A. Astrophys. Lett.; 14: No. 1, 65-68(1973).

Two faint stars in the Mount Wilson Catalogue bear strong similarity to Eta Carinae in their spectra and energy distributions. (auth)

8936 POSSIBLE PRODUCTION OF THE SOFT X-RAY BACKGROUND BY THE CORONAE OF RED GIANTS. Hills, J. G. (Univ. of Michigan, Ann Arbor). Astrophys. Lett.; 14: No. 1, 69-71(1973).

It is found that if stellar mass loss occurs predominantly by means of stellar winds there is a direct proportionality between the optical luminosity of most stellar systems and the integrated soft x-ray luminosity of the coronae of stars evolving off the main sequence in these systems. This results because the rate of stellar mass loss in these systems is proportional to their integrated luminosity, while the integrated x-ray radiation from stellar coronae is in turn directly proportional to the amount of mass being ejected through stellar winds. The predicted soft x-ray emission from these coronae is quite adequate to account for the observed background radiation. (auth)

8937 SPECTROSCOPIC OBSERVATIONS OF HD 50138. Andrillat, Y. (Univ. des Sciences et Techniques du Languedoc, Montpellier, France); Houziaux, L. Astrophys. Space Sci.; 18: No. 2, 324-328(Oct 1972). (In French).

Observations of the Be star HD 50138 were extended to the photographic infrared region up to 9500 Å. The main features noted in this wavelength range were strong lines of O(I) (8446 Å), H(I) (from P9 to P20), the Ca(II) infrared triplet, and the λ8629 line attributed to N(I). The λ7772 multiplet of O(I) is shown to undergo important changes during the period of observations (1959–1971). Higher Balmer lines do not exhibit any emission component, but their profiles are variable and indicate the presence of satellite absorption, as already mentioned by some authors. (auth)

8938 VARIABILITY OF T TAURI-LIKE STARS IN NGC 2264. Nandy, K.; Pratt, N. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 19: No. 1, 219-224(Nov 1972).

The variability of the T Tauri-like stars in NGC 2264 in U, B, V, R, and I colors was studied. It was found that the range of variability in amplitude in I was less than in U, B, and V. A method of determining relative opacities at these wavelengths from the variability in different colors of these dust embedded stars is described. (auth)

8939 SOLUTION OF THE TRANSFER EQUATION FOR INTERLOCKED MULTIPLETS BY PROBABILISTIC METHOD. Das Gupta, S. R.; Karanjai, S. (Univ. of North Bengal, West Bengal, India). Astrophys. Space Sci.; 18: No. 1, 246-253(Sep 1972).

Sobolev's probabilistic method—the method of quantum exit from the medium—was applied to solve the transfer equation for the case of interlocking without redistribution. The solution contains the function $\phi(x)$ which is same as the H-function involved in the solution given by Busbridge and Stibbs by the method of principle of invariance. (auth)

8940 THEORETICAL EVOLUTION OF A HYDROGEN–HELIUM STAR OF 3 $M_\odot$ FROM THE PRE-MAIN SEQUENCE TO THE CORE HELIUM-EXHAUSTION PHASE. Ezer, D. (Goddard Inst. for Space Studies, New York). Astrophys. Space Sci.; 18: No. 1, 226-245(Sep 1972).

The evolution of a first-generation 3 $M_\odot$ star from the threshold of stability through the stage of helium exhaustion in the core was studied. The total time elapsed was 4.174×10^8 yr and most of this time is spent in the blue-giant region of the H–R diagram. Hydrogen-burning near the main sequence occurs at a high central temperature via the proton–proton chain until the triple-alpha reactions generate a small amount of ^{12}C toward the end of the hydrogen-burning phase. The corresponding evolution time is longer than that of a normal population I star with the same mass. The ignition of the triple-alpha processes begins in a mildly degenerate, small convective core while the star still has a high

surface temperature. Helium-burning in the core, coupled with hydrogen-burning in the shell, occupies a period of about 1.8×10^7 yr, which is only one-third that of a normal star. The mass of the star interior to the hydrogen shell source increased to a value of 0.50 $M_\odot$ near the end of core helium exhaustion. This region maintains an inhomogeneous composition composed of helium, carbon, and oxygen. (auth)

8941 CHARGED PARTICLE THERMONUCLEAR REACTIONS IN NUCLEOSYNTHESIS. Truran, J. W. (Yeshiva Univ., New York). Astrophys. Space Sci.; 18: No. 2, 306-323(Oct 1972).

Thermonuclear reaction rates are calculated at temperatures consistent with nucleosynthesis conditions in stars and supernovae ($10^9 \lesssim T \lesssim 10^{10}$ K). The cross sections as a function of energy are determined by averaging over a density of compound nuclear states, an individual resonance contribution being represented by the Breit–Wigner formula. The proton and α-particle channel radii are estimated by fitting experimental (p,n) and (α,n) cross sections for nuclei in the mass range $40 \lesssim A \lesssim 200$. The influence of the diffuseness of the nuclear surface on barrier penetration is taken into account by multiplying the square well penetration factors by a "reflection factor" in the manner described by Vogt et al. (1965). Thermonuclear rates calculated by these procedures are compared with sums over experimentally determined resonance strengths for a number of charged-particle reactions involving medium mass nuclei ($24 \lesssim A \lesssim 40$). (auth)

8942 TIDAL EVOLUTION IN CLOSE BINARY SYSTEM. II. Kopal, Z. (Lunar Science Inst., Houston, TX). Astrophys. Space Sci.; 18: No. 2, 287-305(Oct 1972).

An attempt is made to determine the explicit forms of differential equations which govern secular perturbations of the orbital elements of close binary systems in the plane of the orbit (i.e., of the semi-major axis A, eccentricity e, and longitude of the periastron $\bar{\omega}$), arising from the lag of dynamical tides due to viscosity of stellar material. The results obtained are exact for any value of orbital eccentricity comprised between $0 \leq e < 1$; and include the effects produced by the second, third, and fourth-harmonic dynamical tides, as well as by axial rotation with arbitrary inclination of the equator to the orbital plane. The variational equations of the problem of plane motion are set up in terms of the rectangular components R, S, W of disturbing accelerations with respect to a revolving system of coordinates. The explicit form of these coefficients is established to the degree of accuracy to which squares and higher powers of quantities of the order of superficial distortion can be ignored. A derivation of the explicit form of the variational equations for the case of a perturbing function arising from axial rotation is given and variational equations which govern the perturbation of orbital elements caused by lagging dynamical tides are derived. (auth)

8943 GRAVITY-DARKENING OF THE SECONDARY COMPONENT OF RW MONOCEROTIS. Parthasarathy, M. (Osmania Univ., Hyderabad, India). Astrophys. Space Sci.; 18: No. 1, 190-195(Sep 1972).

The two near-infrared light curves of the secondary minimum of RW Monocerotis were analyzed for the gravity-darkening coefficient of the distorted subgiant secondary component of later spectral type. It was found that the monochromatic gravity-darkening coefficient of the secondary component of RW Monocerotis at wavelengths of 7800 Å and 7000 Å is about twice that obtained from von Zeipel theory. (auth)

8944 STELLAR WINDS AND MASS LOSS OF A ROTATING STAR. De Greve, J. P. (Astrophysical Inst., Brussels); De Jager, C. Astrophys. Space Sci.; 18: No. 1, 128-134(Sep 1972).

The mass loss to be expected from the corona of a rotating F2-star was calculated. The rotation is supposed to be rigid up to a certain distance s, as if it were maintained by a strong magnetic field. Dependent on the values of the rotational velocity the mass loss can increase to 26 to 40% for v_{rot} up to 200 km s^{-1}. (auth)

8945 ORIGIN OF STELLAR MAGNETIC FIELDS. Raychaudhuri, P. (Univ. of Oulu, Finland). Astrophys. Space Sci.; 18: No. 2, 425-436(Oct 1972).

It is pointed out that the magnetic field of a star is originated from dynamo action associated with the stellar evolution. The magnetic field of a star is related to how much nuclear energy is generated in its phase of evolution. From this one can explain why some stars possess a magnetic field higher than that of the Sun. The magnetic field of the star is a by-product of the star's evolution and it has no influence on the internal structure of the star but it does have influence on the flare, chromosphere, and coronal activities of the star. Again it is stressed that to confirm the activities of the star, the details of evolution of stars should be calculated according to the photon–neutrino coupling theory. (auth)

8946 SHOCK WAVES ON NEUTRON STAR CORES. Colgate, S. A.; Chen, Y. H. (New Mexico Inst. of Mining and Tech., Socorro). Astrophys. Space Sci.; 17: No. 2, 325-329(Aug 1972).

A numerical model of the transient behavior of a radiation-dominated shock was calculated in order to demonstrate the relatively large initial escape of internal energy that takes place when the opacity law is a positive power of temperature, as for neutrinos, $K \sim T^2$. Attention was given to the consequences of diffusive transport of radiation versus local production of internal energy by duplicating the calculation with and without artificial viscosity. It is concluded that a shock formed on the neutron star core of an imploding supernova may radiate its internal energy in electron neutrinos more effectively than had hitherto-fore been considered. (auth)

8947 STRUCTURE OF CLOSE BINARIES. IV. Non-synchronous Polytropes. Naylor, M.D.T. (Univ. of Guelph, Ont.). Astrophys. Space Sci.; 18: No. 1, 85-88(Sep 1972).

Models of uniformly rotating nonsynchronous binary polytropes were calculated and compared with the results obtained from the Roche model. It was found that the relative dimensions of the nonsynchronous systems are adequately portrayed by a Roche model but the degree of central condensation affects the minimum separation by an amount which is probably not insignificant. (auth)

8948 STRUCTURE OF CLOSE BINARIES. III. Interior Models of Uniformly Rotating Binaries. Naylor, M.D.T.; Anand, S.P.S. (Univ. of Toronto, Richmond Hill, Ont.). Astrophys. Space Sci.; 18: No. 1, 59-84(Sep 1972).

Internal models were obtained for uniformly rotating synchronous close binary systems using a modified double approximation scheme. Primaries of $10M_\odot$, $5M_\odot$, and $2M_\odot$ with mass ratios of 0.0 to 1.0 in steps of 0.1 were considered and some results are given for a $1M_\odot$ primary with a mass ratio of 1.0. A maximum luminosity reduction of 2.3% was found for a $10M_\odot$ primary with a mass ratio of 1.0 and 7.7% for a mass ratio of 0.0. The corresponding values for $5M_\odot$ are 2.0% and 7.0%, and for $2M_\odot$ they are 1.6% and 5.3%, respectively. These values were not found to be sensitive to small changes in composition. The maximum equatorial velocity varies from 399 km s^{-1} for $2M_\odot$ to 567 km s^{-1} for $10M_\odot$ when the mass ratio is zero, but these velocities decrease by 200 to 300 km s^{-1} if the mass ratio is unity. The effect of gravity darkening on the apparent position of the primary in the theoretical H–R diagram was investigated. It was determined that an unresolved close binary of unit mass ratio can lie up to $\simeq$0.9 magnitudes (depending on inclination) above the main sequence, whereas if the effects of distortion are ignored this number is at most 0.75 magnitudes. There seems to be some observational support for the larger value. Two models of the secondaries are given and their dimensions are compared with their critical Roche lobes. (auth)

8949 HYDROGEN ATOM IN INTENSE MAGNETIC FIELD. Canuto, V.; Kelly, D. C. (Goddard Space Flight Center, New York). Astrophys. Space Sci.; 17: No. 2, 277-291(Aug 1972).

The structure of a hydrogen atom situated in an intense magnetic field is investigated. Three approaches are employed. An elementary Bohr picture establishes a crucial magnetic field strength, $H_a \simeq 5 \times 10^9$ G. Fields in excess of H_a are intense in that they are able to modify the characteristic atomic scales of length and binding energy. A second approach solves the Schrödinger equation by a combination of variational methods and perturbation theory. It yields analytic expressions for the wave functions and energy eigenvalues. A third approach determines the energy eigenvalues by reducing the Schrödinger equation to a one-dimensional wave equation, which is then solved numerically. Energy eigenvalues are tabulated for field strengths of 2×10^{10} G and 2×10^{12} G. It is found that at 2×10^{12} G the lowest energy eigenvalue is changed from -13.6 eV to about -180 eV in agreement with previous variational computations. (auth)

8950 INFRARED EMISSION OF NOVAE. Zentsova, A. S. Vestn. Leningrad. Univ., No. 1, Mat., Mekh., Astron.; No. 1, 131-135(Jan 1973). (In Russian).

The possible sources of the energy conditioning the powerful radiation in the infrared spectral region observed in a number of novae are considered. It is shown that if the infrared radiation is emitted by the dust envelope of novae then the most probable is the heating of the envelope by x rays. Some properties of the hypothetical source of x rays are predicted. (auth)

8951 POST-NEWTONIAN EQUILIBRIUM CONFIGURATIONS OF ROTATING POLYTROPES. Miketinac, M. J.; Barton, R. J. (Univ. of Saskatchewan, Regina). Astrophys. Space Sci.; 18: No. 2, 437-448(Oct 1972).

Post-Newtonian equations are solved numerically for stellar

models with a polytropic pressure–density relation for the case of uniform rotation, no meridional currents, and axial symmetry. The solution is obtained by following Stoeckly's numerical technique. Parameters characterizing the critical configuration are determined and compared with the values obtained recently by Fahlman and Anand, who followed Chandrasekhar's series expansion method. (auth)

8952 IRREGULAR NEBULAR VARIABLES AND NEUTRINO EMISSION. Raychaudhuri, P. (Univ. of Oulu, Finland). Astrophys. Space Sci.; 19: No. 2, 297-301(Dec 1972).

The suggestion that the less massive star will reach the main sequence stage earlier than the massive star due to the effect of neutrino emission according to the photon–neutrino coupling theory is supported by the observed behavior of the H–R diagram of irregular nebular variables. After reaching the main sequence the star should pulsate with a period due to the effect of neutrino emission which may be a possible explanation of other properties of irregular nebular variables. (auth)

8953 ROCHE POTENTIALS INCLUDING RADIATION EFFECTS. Schuerman, D. W. (Dudley Observatory, Albany). Astrophys. Space Sci.; 19: No. 2, 351-358(Dec 1972).

A modified Roche potential which incorporates the effects of radiation pressure due to one component of a binary system is mathematically explored. In some cases, the resulting potentials do not exhibit the familiar contact surfaces of the classical Roche potential. The concept of a contact surface, which has been fundamental to the investigations of close binary systems, must be used with discretion for close binaries in which one component is very luminous. A convenient criterion for the existence of a contact surface is given by $(1-\mu) \simeq 3\delta_c^{\frac{1}{3}}(1+2(\frac{2}{3})^4\delta_c)$, $(\delta_c \ll 1)$ where μ is the mass of the very luminous star in terms of the system mass. For systems of given μ, no contact surface exists if δ is greater than δ_c where δ is the ratio of radiation pressure force to gravitational attraction. Furthermore, energy considerations of the modified Roche potential indicate that binary systems with $\delta > \delta_c$ should have a greater tendency to form rings than those with $\delta < \delta_c$. (auth)

8954 COOLING SEQUENCE OF A PURE HELIUM WHITE DWARF OF 0.15 SOLAR MASSES. D'Antona, F.; Magni, G.; Mazzitelli, I. (CNR, Frascati, Italy). Astrophys. Space Sci.; 19: No. 1, 151–158(Nov 1972).

A new method of integration was performed and applied to the computation of the cooling sequence of a 0.15 $M_\odot$ white dwarf consisting of helium. The results are discussed and compared with the previous ones obtained by other authors. (auth)

8955 MERIDIAN CIRCULATION IN DIFFERENTIALLY ROTATING STARS. McDonald, B. E. (Princeton Univ., NJ). Astrophys. Space Sci.; 19: No. 2, 309–349(Dec 1972).

The first order theory of meridian circulation in radiative zones of approximate chemical homogeneity is formulated so as to allow calculation of circulation velocities in a star subject to an arbitrary axially symmetric angular velocity ω (r, θ). The calculation includes circulation due to perturbations in the nuclear burning rate. The formalism agrees with previous calculations relevant to special cases, and assumes maximum simplicity for rotation on cylinders. Two types of steady state configurations are found: (1) rotation according to a special class of distributions $\omega(r, \theta)$ which drive no currents, and (2) rotation according to arbitrary $\omega(r, \theta)$, but with a correction to the molecular weight μ such that the net circulation velocity is zero. It is found that a small μ gradient can quench the circulation in many cases. In particular, it is concluded that a large differential rotation in the Sun might have escaped disruption by meridian currents, for a μ stratification of a few parts in 10^3. (auth)

8956 CASE FOR A BLACK HOLE IN BM ORIONIS. Wilson, R. E. (Univ. of South Florida, Tampa). Astrophys. Space Sci.; 19: No. 1, 165–171(Nov 1972).

Earlier photometric and spectroscopic observations of the binary BM Ori are interpreted in terms of a thin disk model for the object which causes the eclipses. It is shown that the secondary mass, about which the disk particles orbit, has small dimensions and a mass of 3 to 4 $M_\odot$, which suggests that it can only be a collapsed star. The model requires a history of mass exchange or mass loss for the binary. If the Trapezium stars have been formed within the past 2×10^4 yr, as some studies have indicated, a less conventional alternative, perhaps involving fragmentation of a pre-stellar mass, is needed. Further observations may make it possible to decide for certain between this and a recent model by Hall. (auth)

8957 REGION OF FORMATION OF THE NARROW Fe II LINES OF RS OPHIUCHI. Friedjung, M. (Institut d'Astrophysique, Paris). Astrophys. Space Sci.; 19: No. 2, 501-503 (Dec 1972).

The size of the region is found, using a method previously applied by Friedjung and Malakpur (1971) to Nova Delphini. The conclusion of Pottasch (1967) that the lines are formed in a circumstellar cloud is supported. (auth)

8958 POPULATION II CEPHEIDS IN GLOBULAR CLUSTERS. Caputo, F. (Laboratorio di Astrofisica Spaziale, Frascati, Italy); Castellani, V. Astrophys. Space Sci.; 19: No. 2, 423-429(Dec 1972).

B and V data of Population II Cepheids in M2, M5, M10, M13, M80, and ω Cen are combined in order to obtain period–luminosity and period–color relations. The mean absolute magnitudes are determined adopting as distance modulus the quantity [V(RR) – M_v(RR)], where V(RR) is the apparent mean magnitude of RR Lyrae and M_v(RR) is the absolute magnitude derived from the transition period P_{tr}. It is shown that the scatter of the points around the (P–L) and (P–C) relations depends also from the width of the instability strip. In fact the position of the variables in the instability strip may be correlated with their amplitude in the sense that the short period variables (log P < 1) which have largest amplitudes are brightest and bluest while the long period variables (log P > 1) show a reversed relation. Finally, after correcting the observed colors for the amplitude effect, period–color–amplitude relations are derived for both short and long period variables. (auth)

8959 ROLE OF THE CORIOLIS FORCE ON THE STABILITY OF ROTATING MAGNETIC STARS AND THE ORIGIN OF CONVECTIVE MOTIONS. Sakurai, K. (Goddard Space Flight Center, Greenbelt, MD). Astrophys. Space Sci.; 19: No. 2, 417-421(Dec 1972).

Based on the method of the energy principle, the effect of the Coriolis force in the stability of rotating magnetic stars is examined and the conditions for instability is derived. It is shown that, in these stars, the effect of this force is to inhibit the onset of convective motion. Discussion is given on the possibility of hydromagnetic dynamo processes in respect to the convective motion inside these stars. (auth)

8960 ELECTRIC FIELD AROUND AN ACCRETING STAR. Anile, A. M. (Oxford Univ.); Treves, A. Astrophys. Space Sci.; 19: No. 2, 411-415(Dec 1972).

The accretion of matter on a neutron star is considered. The electric field is studied in the case of a null magnetic field and of a dipole field. The relevance of the results for models of x-ray sources is examined. (auth)

8961 PROBABILISTIC MODEL FOR TIME-DEPENDENT TRANSFER PROBLEMS IN FINITE CYLINDRICAL SHELL MEDIUM. Leong, T. K. (Univ. of Singapore). Astrophys. Space Sci.; 19: No. 2, 369-385(Dec 1972).

A time dependent probabilistic model for the description of photon diffusion in infinite cylindrical shell media is proposed. Four basic probability functions are defined and an integro-differential equation for the scattering function is derived. The expressions for the emergent intensities expressed in terms of the scattering, transmission, back scattering, and back transmission functions are obtained for two special cases. (auth)

8962 NEUTRINO ENERGY LOSS IN NEUTRON STAR MATTER. Itoh, N.; Tsuneto, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6, 1849-1859(Dec 1972).

The theory of the energy loss due to neutrino processes in neutron stars is formulated in such a form that one can include the effect of strong interaction systematically. As an application the rates of energy loss are calculated for the following cases of interest in the study of neutron stars; (i) the neutron and the proton liquid are both normal, (ii) the proton or (iii) the neutron liquid is in the superfluid state. The results largely confirm the earlier calculations by Bahcall and Wolf and by Wolf. The rate of energy loss in the state of nuclei coexisting with free neutrons is also discussed. (auth)

8963 VELOCITY DISTRIBUTION OF O–B STARS IN ASSOCIATIONS. Mirzoyan, L. V.; Mnatsakanyan, M. A. (Byurakan Astrophysical Lab., Erevan). Astrophysics (Engl. Transl.); 6: No. 3, 221-231(1970).

Translated from Astrofizika; 6: No. 3, 411-429(1970).

The velocity distribution of O–B stars in a synthetic association was investigated. A method is presented for the determination of the mean velocity in spherically symmetric systems at different distances from the center, using their residual radial velocities and the distribution projected on the celestial sphere. By applying this method to the synthetic association it is shown that the dependence of the mean space velocity of the stars on the distance from

the center of the system is a linearly increasing function. Possible interpretations of this result are discussed. The only interpretation not in conflict with observational data (distribution of stellar intensity in associations, stellar masses, and so on) is that based on the assumption of expanding associations. This leads to the conclusion that the linearly increasing function v(r) can be regarded as important evidence for the expansion of associations and indicates that most known stellar associations are dynamically unstable. (auth)

8964 DIFFUSION OF RADIATION IN A ONE-DIMENSIONAL MOVING MEDIUM. Vityazev, V. V. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 3, 232-241(1970).

Translated from Astrofizika; 6: No. 3, 431-444(1970).

The diffusion of radiation in a line for a one-dimensional isothermal medium moving with a constant velocity gradient is considered. The absorption-coefficient profile is assumed to be arbitrary, and it is assumed that each elementary scatter takes place with complete frequency redistribution. The intensity of the emerging radiation is expressed in terms of auxiliary functions for which three sets of equations are established. (auth)

8965 EFFECT OF ELECTRON SCATTERING IN STELLAR ATMOSPHERES ON EMISSION AND ABSORPTION LINE PROFILES. Vedmich, V. G. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 6: No. 3, 242-252(1970).

Translated from Astrofizika; 6: No. 3, 445-461(1970).

The transfer of radiation in a layer of electrons is considered. It is assumed that the scattering is isotropic and takes place with frequency redistribution which depends on the modulus of the photon frequency difference before and after scattering. The profiles of emission lines originating in the layer are calculated for a uniform distribution of primary radiation sources inside it. The profiles of absorption lines produced during the propagation of photospheric radiation through an electron atmosphere are determined. The calculations are carried out for a uniform distribution of brightness over the stellar disk and for the Eddington limb-darkening law. (auth)

8966 EMISSION OF MAGNETOHYDRODYNAMIC WAVES BY ROTATING MAGNETIC STARS AND PLANETS. Dokuchaev, V. P. (Scientific-Research Radiophysics Inst., Gorky, USSR). Astrophysics (Engl. Transl.); 6: No. 3, 257-266(1970).

Translated from Astrofizika; 6: No. 3, 471-487(1970).

The emission of Alfvén waves and magnetosonic waves by inclined magnetic rotators, i.e., magnetic stars and planets whose axes of rotation do not coincide with the magnetic axes, is discussed. The nature of perturbations in the magnetoactive plasma surrounding these sources is determined. Expressions are obtained for the intensity of the Alfvén and magnetosonic waves. It is shown that magnetic stars and planets lose rotational kinetic energy and angular momentum as a result of emission of Alfvén waves. The effectiveness of this energy-loss mechanism in the case of certain stars and planets is estimated. (auth)

8967 ACCRETION OF MATTER BY A NEUTRON STAR IN A BINARY SYSTEM. I. Amnuel, P. R.; Guseinov, O. Kh. Astrophysics (Engl. Transl.); 6: No. 3, 214-217(1970).

Translated from Astrofizika; 6: No. 3, 397-403(1970).

The capture of an incident plasma stream by the dipole magnetic field of a neutron star is discussed. The shape of the capture front (possibly a shock-wave front), which is produced when the plasma is brought to rest, is calculated. The calculation is performed in two cross sections, namely, polar and equatorial. It is shown that the distance of the front from the neutron star during accretion in a binary system is of the order of 10^8 cm. The symmetric accretion and capture of plasma by the magnetic field of a single neutron star are considered. An analytic expression is obtained for the radius vector of the capture point. The magnetic field of the neutron star shifts the spectrum toward longer wavelengths, and leads to a highly directional emission of radiation. (auth)

8968 EFFECT OF LINE BLANKETING IN F–G STARS. Rodriguez, M. G. (Main Astronomical Observatory, Kiev). Astrophysics (Engl. Transl.); 6: No. 3, 279-282(1970).

Translated from Astrofizika; 6: No. 3, 513-519(1970).

The blocking and back-warming effects of absorption lines on V and B magnitudes are evaluated for F–G stars of differing luminosity. The back-warming effect is found to predominate over blocking in the V band while blocking predominates in the B band. (auth)

8969 STABILITY OF SLOWLY ROTATING CONFIGURATION EXHIBITING PHASE TRANSITIONS. Seidov, Z. F. (Shemakin Astrophysical Observatory, Baku). Astrophysics (Engl. Transl.); 6: No. 3, 283-285(1970).

Translated from Astrofizika; 6: No. 3, 521-524(1970).

The stability of stars exhibiting phase transitions at the center in the case of slow solid-body rotation is considered. The critical value of the density ratio $q = \rho_2/\rho_1$ across the phase transition is determined. The star becomes unstable at this critical value when the new phase is formed. The critical value is given by $q = 1.5 - \omega^2/4\pi G\rho_1$ whatever the equations of state, where ω is the angular velocity and G is the gravitational constant. The example of a star with a phase transition when the material before and after the phase transition is incompressible is considered. This problem has an analytic solution. (auth)

8970 INTERACTION OF PROTO-STARS IN A COLLAPSING CLUSTER. Arny, T.; Weissmann, P. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Astron. J. 78: No. 4, 309-315 (May 1973).

The collapse and early evolution of a cluster of proto-stars is studied with an n-body integration. Each proto-star is assigned an initial radius which decreases with time. As the cluster collapses, random transverse velocities rapidly grow and orbital mixing occurs which prevent the fragments from reaching the center simultaneously. Roughly 50% of all fragments suffer very close encounters or physical collisions during the initial collapse of the cloud, unless the fragment radii shrink four times as fast as the cluster itself. This suggests that the usual picture of isolated collapse from interstellar cloud to pre main sequence star is in need of more critical analysis. In particular, angular momentum loss to the surrounding medium must occur far more rapidly than usually supposed, and in its early evolution a star may acquire large additional amounts of mass via inelastic collisions with other proto-stars. (auth)

8971 LOW-MASS PRIMARY FOR CYGNUS X-1. Trimble, V.; Rose, W. K.; Weber, J. (Univ. of Maryland, College Park). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 1P-3P(1973).

If the primary of HDE 226868 (Cyg X-1) is a low-mass (0.3 to 0.5 $M_\odot$), low-surface gravity B star of the type of which the primary of HZ 22 is the prototype, then the secondary falls well within the mass range of stable neutron stars (and white dwarfs), and need not be a black hole. (auth)

8972 MAGNETOHYDRODYNAMIC STABILITY OF WHITE DWARFS AND NEUTRON STARS. Tayler, R. J. (Sussex Univ., Brighton, Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 17-23(1973).

Vandakurov (Sov. Astr.; 16: 265(1972)) has recently suggested that, as a degenerate gas has an equation of state in which the pressure is essentially a function of density alone, an arbitrarily weak destabilizing magnetic field may lead to the occurrence of convection in superdense stars. It is pointed out here that, when thermal corrections to the equation of state are included, instability is unlikely to occur throughout a large region of such a star unless the magnetic pressure exceeds the thermal correction to the ideal degenerate pressure. In the case of white dwarfs it appears that the necessary magnetic fields for instability are several orders of magnitude stronger than those which are generally believed to exist in the stars. In contrast, it seems possible that strong enough magnetic fields to cause instability could be present in neutron stars and the problem appears to be worthy of more detailed study. The calculations have been performed assuming that the stellar material is a fluid. The possibility of crystallization in white-dwarf interiors strengthens the view that magnetohydrodynamic instabilities are unlikely to be important. In a neutron star, the magnetic field may only be strongly coupled to the electrons and protons. If this is so, the probability of the occurrence of instability is affected only slightly but the character of the instability is changed. (auth)

8973 SPECTROSCOPIC OBSERVATIONS OF M GIANT STARS AT THE SOUTH GALACTIC POLE. Crampton, D.; Evans, T. L. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 11-15(1973).

Radial velocities and spectral types determined from slit spectra are presented for 30 M giant stars within 30° of the South Galactic Pole. They have been divided by Eggen (Astrophys. J., Suppl. Ser.; 22, 289 (1970)) into young disk, old disk, and halo groups on the basis of their space motions parallel to the galactic plane. The velocities found in the present paper, together with those in the literature giving 67 stars in all, show an increase in velocity dispersion from the youngest to the oldest group. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 8901, 8971, and 9109.

8974 (AD-752497) OBSERVATIONS OF THE NEUTRAL HYDROGEN ABSORPTION SPECTRUM OF CYGNUS X-3. Chu,

K. W.; Bieging, J. H. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 11p. NTIS.

Interferometric observations were made of the neutral hydrogen absorption spectrum of Cygnus X-3. The radio source is more than 10.4 kpc from the Sun, and the columnar density of neutral hydrogen along the line of sight is at least 1.7×10^{20} T_s/cm^2. (auth) (NTIS)

8975 OCCULTATION OBSERVATIONS OF SIX RADIO SOURCES WITH FLAT SPECTRA. Kapahi, V. K.; Joshi, M. N.; Kandaswamy, J. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Lett.; 14: No. 1, 31-36(1973).

Accurate radio positions and high-resolution structures derived from lunar occultations observed at 327 MHz, together with accurate optical positions measured from the Sky Survey prints, are presented for six radio sources with flat or peaked spectra. From a total of about 500 radio sources observed in the Ooty occultation survey, nine can be classified in this spectral category on the basis of existing measurements at higher frequencies. All the nine sources show compact components unresolved with resolutions of 1 or 2 arc sec and are optically identified. (auth)

8976 PULSARS: PROPERTIES OF PSR 0301 + 19 AND PSR 2020 + 28. Schoenhardt, R. E. (Institut fuer Astrophysik und Extraterrestrische Forschung, Bonn); Sieber, W. Astrophys. Lett.; 14: No. 1, 61-64(1973).

A power-fluctuation spectrum analysis as a function of phase in the pulse window is presented for the pulsars PSR 0301 + 19 and PSR 2020 + 28. For both pulsars periodic power fluctuations were found, which, in the case of PSR 0301 + 19, can be shown to be due to a drifting subpulse phenomenon. (auth)

8977 TEST OF TSAREVSKY'S PULSAR–SUPERNOVA ANALYSIS. Combe, V.; Large, M. I. (Univ. of Sydney). Astrophys. Lett.; 14: No. 1, 59-60(1973).

The correlation between supernova distance and pulsar dispersion measure is attributed to the similar spatial distributions of supernova and pulsars. (auth)

8978 FOUR-DIMENSIONAL GREEN'S FUNCTION APPROACH TO THE CALCULATION OF GRAVITATIONAL RADIATION FROM A PARTICLE FALLING INTO A BLACK HOLE. Chung, K. P. (IBM Watson Research Center, Yorktown Heights, NY). Nuovo Cim.; 14B: No. 2, 293-308(11 Apr 1973).

A four-dimensional Green's function method to calculate the gravitational radiation from a particle moving in the field of a black hole is described in detail. This technique is applicable even to problems in which the background geometry has no symmetry. An explicit example of the Schwarzschild black hole is worked out, and a comparison of the projection of the results onto definite angular momenta shows excellent agreement with the literature. (auth)

8979 MASS AND DISTANCE OF THE QUASI-STELLAR OBJECT 3C 273. Falla, D. F.; Evans, A. (University Coll. of Wales, Aberystwyth). Astrophys. Space Sci.; 15: No. 3, 395-400 (Mar 1972).

For the QSO 3C 273, on the basis of two different theoretical models, expressions are derived for a lower limit to the mass of the QSO, as a function of its distance. It is concluded that an appreciable gravitational redshift component is consistent with the observational data only if the QSO mass is at least galactic in magnitude. The setting of an independent upper limit to the QSO mass $M \lesssim 10^{10} M_\odot$ could indicate that the QSO redshift is predominantly cosmological in nature. (auth)

8980 THERMAL RADIATION SPECTRA OF SUPERMASSIVE STARS AND X-RAY SOURCES. Illarionov, A. F.; Sunyaev, R. A. (Inst. of Applied Mathematics, Moscow). Astrophys. Space Sci.; 19: No. 1, 61-74(Nov 1972).

In the external layers of supermassive stars and thermal sources of x-ray radiation electron scattering contributes more to the opacity than the free–free process. Therefore, the thermal radiation spectrum of supermassive stars must greatly differ from Planckian. The approximate formulae obtained for the radiation spectra are applicable to any objects with a predominant role of electron scattering in the opacity and power dependence of plasma temperature and density on geometrical depth of the layers. In thermal radiation sources with power dependence of plasma temperature on depth of the layer the formation of power radiation spectra $F(\nu) \sim \nu^{-\alpha}$ with $\alpha > 0$ is possible. Such spectra can imitate the presence of nonthermal radiation mechanisms. This effect takes place also in the case of small optical depth on the Thomson scattering. Possibly, this effect is of interest for the theories of x-ray sources and x-ray solar flares. (auth)

8981 POSSIBILITY OF CONTINUOUS MONITORING OF CELESTIAL X-RAY SOURCES THROUGH THEIR IONIZATION EFFECTS IN THE NOCTURNAL D-REGION IONOSPHERE. Sharma, D. P.; Jain, A. K.; Chakravarty, S. C.; Kasturirangan, K.; Ramanathan, K. R.; Rao, U. R. (Physical Research Lab., Ahmedabad, India). Astrophys. Space Sci.; 17: No. 2, 409-425(Aug 1972).

The electron production rates in the nighttime D region arising from the transit of strong celestial x-ray sources Sco X-1, Tau X-1, and the galactic center are estimated and compared with the ambient electron production rates resulting from other known stable agencies. Using the experimentally measured values of the nighttime electron densities, the number of additional electrons/cc expected from the passage of these sources is computed. For the 164 kHz transmission from Tashkent, received at Ahmedabad, the associated enhancement in the attenuation is calculated using the full wave admittance technique of Barron and Budden. Reasonable agreement is shown to exist between the calculated values of the attenuation and those of direct observations. (auth)

8982 CIRCULAR POLARIZATION OF SOURCES OF SYNCHROTRON RADIATION. Sazonov, V. N. (Lebedev Inst. of Physics, Moscow). Astrophys. Space Sci.; 19: No. 1, 25-45(Nov 1972).

The degree of circular polarization is calculated for two models of a source of synchrotron radiation: (1) A source with an inhomogeneous magnetic field and isotropic angular distribution of the electrons with respect to the magnetic field; (2) A source with a homogeneous magnetic field and anisotropic angular distribution of the electrons in which the anisotropy of angular distribution substantially increases with the electron energy. The first model can be used to describe extended radio sources; and the second, to describe compact radio sources. (WDM)

8983 BALLOON-BORNE OBSERVATION OF THE X-RAY SOURCE CYGNUS XR-1. Metzger, A. E. (California Inst. of Tech., Pasadena); Dolan, J. F. Astrophys. Space Sci.; 17: No. 2, 482-488(Aug 1972).

An observation of the variable x-ray source Cygnus XR-1 was made with a balloon-borne proportional counter in the energy region 22 to 70 keV. The resultant spectrum indicated that the source was in a state of maximum flux during the time period 1915-2005 UT, January 15, 1968. (auth)

8984 DIRECT REDUCTION OF ASTRONOMICAL X-RAY SPECTRA. Dolan, J. F. (Case Western Reserve Univ., Cleveland). Astrophys. Space Sci.; 17: No. 2, 472-481(Aug 1972).

A matrix method is outlined for the reduction of astronomical x-ray spectra data which includes the effects of detector resolution and fluorescent escape phenomena. The differences between this method and the 'backward reduction' or multiple grid methods presently employed are discussed. (auth)

8985 EQUILIBRIUM, STABILITY, AND EVOLUTION OF A ROTATING MAGNETIZED GASEOUS DISK. Bisnovatyi-Kogan, G. S.; Blinnikov, S. I. (Inst. of Applied Mathematics, Moscow). Astrophys. Space Sci.; 19: No. 1, 119-144(Nov 1972).

The exact solutions for the equilibrium of rotating gaseous disk with poloidal magnetic field are obtained. The stability of the disk with respect to uniform expansion and contraction is investigated by means of the variational principle. It is shown that if the equilibrium is determined by gravitational and magnetic forces only, the disk is in neutral equilibrium with respect to perturbations of the form $\delta r = \alpha r$. The instability to short-wave perturbations is studied by the quasi-classical method. The analysis shows that if the magnetic field is $H > 2\pi\sigma\sqrt{G}$, where σ is the surface density, then these perturbations are stabilized. The configurations of the electrical field induced by the rotation of magnetized disk are found. In conclusion, the questions of the evolution of the disk are discussed in connection with the quasar model when pulsar-like radiation is taken into account. (auth)

8986 PULSAR MAGNETOSPHERE. Cohen, J. M. (Univ. of Pennsylvania, Philadelphia); Rosenblum, A. Astrophys. Space Sci.; 16: No. 1, 130-136(Apr 1972).

Pulsars are presently believed to be rotating neutron stars with large frozen-in magnetic fields normally assumed to be dipole fields. It has been shown that such a star must possess a magnetosphere if it rotates sufficiently rapidly. By assuming that the magnetic field is dipolar, and unaffected by the trapped particles in the magnetosphere, and that the field dipole axis is parallel to the rotation axis, Goldreich and Julian determined many of the properties of the magnetosphere. A self-consistent model of the closed field lines of a pulsar magnetosphere is given. Using this model, it is shown that, close to the star, the above assumptions of Goldreich and Julian are justified. Their results are extended to the oblique rotator as well as to stars with magnetic multipoles of arbitrary order and arbitrary orientation. (auth)

8987 SOURCE MODELS WITH ELECTRON DIFFUSION. Gratton, L. (Univ., Rome). Astrophys. Space Sci.; 16: No. 1, 81-100(Apr 1972).

The general solution for the energy distribution of relativistic electrons in which electrons generated within the source diffuse and decay through synchrotron or Compton radiation is given for the case in which the magnetic field and the diffusion coefficient are constant. A very simple spherically symmetric model with an electron point-source at the center is considered and the equations are explicitly solved. It is shown that notwithstanding its great simplicity this model gives a fair representation of the continuous emission of the Crab Nebula from the radio to the x-ray region, with the simple assumption that it is due only to ordinary synchrotron radiation. If the central point source is identified with the pulsar there appears to be an upper limit of about 10^7 MeV to the energy of the electrons accelerated by the pulsar mechanism. (auth)

8988 ABSORPTION EFFECTS IN SIX H II REGIONS. Gianotti, H. F.; Quiroga, R. J.; Varsavsky, C. M. (Instituto Argentino de Radioastronomia, Villa Elisa, Argentina). Astrophys. Space Sci.; 17: No. 1, 126-133(Jul 1973).

The profile of the 21-cm line of neutral hydrogen in the direction of six H II regions (RCW 38, RCW 49, RCW 57(b), RCW 74, W22, and W37) was measured. By comparison with line profiles outside the nebulae the absorption profiles corresponding to each H II region were deduced. The results were compared with those of other authors in the 21-cm line, in the line of OH, and in the recombination lines of hydrogen. (auth)

8989 REDSHIFT OF OH 471. Carswell, R. F.; Strittmatter, P. A. (Univ. of Arizona, Tucson). Nature (London); 242: No. 5397, 394-395(6 Apr 1973).

Attention is drawn to the very large redshift of the quasar OH 471, and the matter is discussed. The object was studied spectroscopically using the Cassegrain image tube spectrograph at the Steward Observatory 90 inch telescope. Two spectrograms were obtained, covering the range 3200 to 5800Å at a dispersion of ~ 240Å/mm, both clearly showing strong emission features at 4548 and 5351Å, and the results indicated a redshift of 3.40 for OH 471. Additional evidence is also presented for this derived value of Z. Amongst other things the spectrum of OH 471 is rich in absorption lines, suggesting a high redshift. If quasar redshifts are due mainly to Hubble expansion, OH 471 is the most distant object so far known, as well as among the most intrinsically luminous. (UK)

8990 OBSERVATION OF COSMIC SOFT X RAYS. Hayakawa, S.; Kato, T.; Kohno, T.; Nishimura, K.; Tanaka, Y.; Yamashita, K. (Nagoya Univ., Japan). Astrophys. Space Sci.; 17: No. 1, 30-38(Jul 1972).

Cosmic x rays in the energy range between 0.2 ~ 10 keV were observed with polypropylene window proportional counters on board a sounding rocket. The field of view crossed the galactic plane in the Sgr region and reached galactic latitudes of 50° and −90°. A new soft x-ray source was found in the Aries−Taurus region. The soft x-ray flux from the direction of NGC 1275 was conspicuous, whereas that of Sgr region source was very weak. The distribution of the intensity of diffuse soft x-rays over the scanned region indicates the galactic emission of soft x-rays. (auth)

8991 NATURE OF RADIO EMISSION FROM PULSARS. Rengarajan, T. N. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space. Sci.; 17: No. 1, 65-68(Jul 1972).

It is shown that radio emission from pulsars is unlikely to be of coherent synchrotron origin if the surface magnetic field of the central neutron star is greater than 10^8 G. (auth)

8992 QUANTUM THEORY OF THE DIELECTRIC CONSTANT OF A MAGNETIZED PLASMA AND ASTROPHYSICAL APPLICATIONS. I. Theory. Canuto, V. (Goddard Space Flight Center, New York); Ventura, J. Astrophys. Space Sci.; 18: No. 1, 104-120(Sep 1972)

A quantum mechanical treatment of an electron plasma in a constant and homogeneous magnetic field is considered, with the aim of (a) defining the range of validity of the magnetoionic theory (b) studying the deviations from this theory, in applications involving high densities, and intense magnetic field. While treating the magnetic field exactly, a perturbation approach in the photon field is used to derive general expressions for the dielectric tensor $\epsilon_{\alpha\beta}$. The properties of $\epsilon_{\alpha\beta}$ are explored in the various limits. Numerical estimates on the range of applicability of the magnetoionic theory are given for the case of the "one-dimensional" electron gas, where only the lowest Landau level is occupied. (auth)

8993 INCOHERENT RADIATION FROM RELATIVISTIC ELECTRONS WITH POWER ENERGETIC SPECTRUM. Getmantsev, G. G.; Tokarev, Yu. V. (Radiophysical Research Inst., Gorky, USSR). Astrophys. Space Sci.; 18: No. 1, 135-140(Sep 1972).

It is shown that an incoherent high-frequency radiation from an ensemble of relativistic particles with the power energy distribution is described by a certain general expression which covers practically all the cases of particle radiation in random electromagnetic fields of cosmic radiation sources. (auth)

8994 NONLINEAR COMPTON AND INVERSE COMPTON EFFECT. Stewart, P. (Univ. of Manchester, Eng). Astrophys. Space Sci.; 18: No. 2, 377-386(Oct 1972)

A charged particle of arbitrary initial motion and position is subjected to an intense circularly polarized electromagnetic wave. The electromagnetic radiation which results is calculated exactly and the results are expressed in terms of the power observed per unit bandwidth per unit solid angle. Several special cases are considered in order to demonstrate the range of possibilities which this type of interaction may have in astrophysics and numerical examples are given for the Crab pulsar. (auth)

8995 TIME-DEPENDENT RADIATION TRANSFER AND A POSSIBLE EXPLANATION OF THE INTERPULSE IN CP 0950. DeAngelis, U. (Osservatorio Astronomico di Capodimonte, Naples); Taff, L. G. Astrophys. Space Sci.; 18: No 1, 21-33(Sep 1972).

The time-dependent equation of radiative transfer is solved exactly and in the n-th Gaussian approximation. The atmosphere is plane-parallel and semi-infinite; isotropic scattering is assumed, but the boundary condition at $\tau = 0$ is arbitrary. The results are used to investigate a suggested mechanism for the origin of the secondary pulses in CP 0950; it is found that a binary system of neutron stars can indeed explain formation, time delay, and intensity of the observed interpulse. (auth)

8996 COCOON MODEL FOR THERMAL X-RAY SOURCES AND OSCILLARS. Apparao, K. M. V. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 18: No. 2, 334-336 (Oct 1972).

A gas cocoon surrounding a neutron star can be heated to a high temperature by the low-frequency radiation emitted by the neutron star whose rotation axis is inclined to its magnetic axis. This heated gas can emit x rays and may be identified with thermal x-ray sources. If the neutron star emission shows periodicities larger than the cooling time of the gas, these will be reflected in the emission of x rays; the recently observed x-ray sources which show oscillations and quasi-periodicities ("oscillars") may be such sources. (auth)

8997 ENERGY SPECTRUM AND TIME VARIATIONS OF HARD X-RAYS FROM CYG X-1. Agrawal, P. C.; Gokhale, G. S.; Iyengar, V. S.; Kunte, P. K.; Manchanda, R. K.; Sreekantan, B. V. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 18: No. 2, 408-424(Oct 1972).

Experimental results on the intensity, energy spectrum, and time variations in hard x-ray emission from Cyg X-1 based on a balloon observation made on April 6, 1971 from Hyderabad are described. The average energy spectrum of Cyg X-1 in the 22 to 154 keV interval is best represented by a power law $dN/dE = (5.41 \pm 1.53)\ E^{-(1.92 \pm 0.10)}$ photons $cm^{-2}\ s^{-1}\ keV^{-1}$ which is in very good agreement with the spectrum of Cyg X-1 derived from an earlier observation made on April 16, 1969 in the 25 to 151 keV band and given by $dN/dE = (3.54 \pm 2.44)\ E^{-1.89 \pm 0.22)}$ photons $cm^{-2}\ s^{-1}\ keV^{-1}$. A thermal bremsstrahlung spectrum fails to give a good fit over the entire energy range for both the observations. Comparison with the observations of other investigators shows that almost all balloon experiments consistently give a spectrum of $\sim E^{-2}$, while below 20 keV the spectrum varies from $E^{-1.7}$ to E^{-5}. There is some indication of a break in the Cyg X-1 spectrum around 20 KeV. Spectral analysis of data in different time intervals for the 1971 April 6 flight demonstrates that while the source intensity varies over time scales of a few minutes, there is no appreciable variation in the spectral slope. Analysis of various hard x-ray observations for long-term variations shows that over a period of about a week the intensity of Cyg X-1 varies up to a factor of four. The binary model proposed by Dolan is examined and the difficulties in explaining the observed features of Cyg X-1 by this model are pointed out. (auth)

8998 TIME VARIATIONS OF HARD X RAYS FROM SCO X-1. Matsuoka, M. (Tokyo Univ.); Fujii, M.; Miyamoto, S.; Nishimura, J.; Oda, M.; Ogawara, Y.; Hayakawa, S.; Kasahara, I.; Makino, F.; Tanaka, Y.; Agrawal, P. C.; Sreekantan, B. V. Astrophys. Space Sci.; 18: No. 2, 472-490(Oct 1972).

Simultaneous hard x-ray and optical observations of Sco X-1 were carried out on May 1, 1971 at Hyderabad, India, when Sco X-1 was optically bright. The x-ray intensity observed by balloon-borne counter telescopes increased in coincidence with optical enhancements, while the plasma temperature derived by fitting the x-ray spectrum in the energy range 20 to 40 keV to the thermal bremsstrahlung spectrum did not appreciably change over the whole period of observation. (auth)

8999 SOME TRENDS IN THE REDSHIFT DISTRIBUTION OF QUASI-STELLAR OBJECTS AND RELATED PECULIAR GALAXIES. Basu, D.; Abdu, M. A. (Univ. Machenize, Sao Paulo, Brasil). Astrophys. Space Sci.; 19: No. 2, 303–308(Dec 1972).
Gaps in the redshift distribution of quasi-stellar objects and related peculiar galaxies were studied using 205 sources. The result indicates certain definite trends in the distribution of the gaps but does not suggest any periodicity when the entire sample is considered. (auth)

9000 RADIATIVE LOSSES IN A MAGNETOSTATIC AND INTENSE ELECTROMAGNETIC FIELD. Standeven, H. R.; Stewart, P. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 19: No. 1, 181–187(Nov 1972).
The average energy radiation rate is calculated exactly for the case of a charged particle injected with arbitrary momentum into an intense electromagnetic field which is propagating along a uniform magnetostatic field. The treatment is relativistic. (auth)

9001 GENERALIZED ELECTROMAGNETIC TORQUE ON A VACUUM PULSAR MODEL. Soper, S. R. K. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 19: No. 1, 249–258(Nov 1972).
The Deutsch solution to the electromagnetic field in a vacuum surrounding a perfectly conducting obliquely rotating sphere with a dipolar distribution of magnetic flux is extended to the oblique rotator with a general axisymmetric surface flux. It is shown that the torque component perpendicular to the rotation axis is always of opposite sign to the decelerating component parallel to the rotation axis. It is emphasized that this unambiguous result may not apply to more realistic pulsar models with magnetospheres containing charges. (auth)

9002 PHYSICAL PARAMETERS FOR CENTAURUS X-3 AND HERCULES X-1. McCluskey, G. E. Jr. (Lehigh Univ., Bethlehem, PA); Kondo, Y. Astrophys. Space Sci.; 19: No. 2, 279–284 (Dec 1972).
Upper and lower limits on the physical parameters for Cen X-3 and Her X-1 were computed from a simple assumption involving the mass function. (auth)

9003 INFRARED SPECTRA OF QUASARS AND RELATED OBJECTS. Dorschner, J. (Univ., Jena, Ger.); Friedemann, C.; Guertler, J.; Oleak, H.; Schmidt, K. H. Astrophys. Space Sci.; 19: No. 2, 263–270(Dec 1972).
An attempt is made to explain the infrared radiation observed for several quasars and Seyfert galaxies as thermal radiation of a dust envelope surrounding the cores of these objects. Two kinds of dust particles (graphite and silica) are taken into consideration. It is shown that the observed spectral behavior and the luminosity in the infrared can be introduced as thermal radiation of silica grains. In the case of 3C 273 one finds that the radius of the dust envelope is about 50 pc and the total mass of dust is about 600 $M_{\odot}$. (auth)

9004 STATISTICAL ANALYSIS OF MULTIPLE ABSORPTION SPECTRA IN QSO. Shaviv, G. (Cornell Univ., Ithaca, NY); Feldman, U.; Koslovsky, B. Z. Astrophys. Space Sci.; 19: No. 1, 159–163(Nov 1972).
A detailed statistical analysis was carried out for several quasars with multiple redshift systems. The most important results were (a) The statistical test of the reliability of a z-system is very sensitive to z, the total number of absorption lines, the selected set of reference lines, and the number of identified lines (b) The standard deviation σ from μ, the average number of random z-systems per random spectra is larger than μ. Consequently, the reliability of any system depends predominately on σ and not on μ. (auth)

9005 BRIGHTEST INFRARED SOURCES. Neugebauer, G.; Becklin, E. E. Sci. Amer.; 228: No. 4, 28-40(Apr 1973).
An attempt is made to summarize the current thinking about various types of infrared objects by describing the brightest and most conspicuous sources in the sky as they are observed at 2, 20, and 100 μ. These sources encompass a wide range of objects and include a sample of practically every interesting infrared source currently being studied in detail. (WDM)

9006 COMPARISON OF FAR-INFRARED, OPTICAL, AND RADIOFREQUENCY DATA OF DIFFUSE NEBULAE. Johnson, Hugh M. (Lockheed Missiles and Space Company, Palo Alto, California). Astrophys. J. Lett. 180: No. 1, L7-L10 (15 Feb 1973).
The relation of far-infrared grain emission to bremsstrahlung in gas-and-dust nebulae is discussed. Application is made to diffuse nebulae in a 100-μ catalog which are identified with sources in 6-cm catalogs. Comments are made on some individual objects and on the significance of the observed S(100 μ)/S(6 cm) ratio of flux densities. (auth)

9007 ON THE MASSES OF X-RAY SOURCES. Leach, Robert W.; Ruffini, Remo (Joseph Henry Laboratories, Princeton, New Jersey). Astrophys. J. Lett. 180: No. 1, L15-L18 (15 Feb 1973).
An analysis of X-ray sources based on the Roche model is here presented. On this basis we can conclude that pulsating sources appear to have systematically smaller masses than nonpulsating sources. We suggest identifying the first objects as neutron stars and the second as totally collapsed objects or black holes. Detailed predictions are presented. Discriminating features between neutron stars and black holes are also given. (auth)

9008 THE X-RAY SURFACE BRIGHTNESS OF THE CYGNUS LOOP. Stevens, J. C.; Garmire, G. P. (California Institute of Technology). Astrophys. J. Lett. 180: No. 1, L19-L26 (15 Feb 1973).
The surface brightness of the Cygnus Loop in X-rays was obtained on a scale of 0.25 deg^2. The X-ray emission shows strong limb brightening, implying a shell-like source structure. The shell exhibits several regions of enhanced emission. X-ray emission which was observed from a region near the center of the Loop may be from a remnant object. The correlation between X-ray and optical emission is not as good as the correlation between radio and optical emission. (auth)

9009 VLBI OBSERVATIONS OF THE CRAB NEBULA PULSAR. Vandenberg, N. R.; Clark, T. A.; Erickson, W. C.; Resch, G. M. (Astronomy Program, University of Maryland, College Park, and Radio Astronomy Branch, Goddard Space Flight Center); Broderick, J. J.; (and others). Astrophys. J. Lett. 180: No. 1, L27-L29 (15 Feb 1973).
Observations of the Crab Nebula pulsar at meter wavelengths using VLBI techniques have been made. At 196.5 MHz we observe no resolution of the pulsar, all the pulse shapes observed with the interferometers are similar to single-dish profiles, and all the power pulsates. At 111.5 MHz besides the pulsing power there is always a steady component, presumably due to multipath propagation effects. The pulsar is slightly resolved at 111.5 MHz with an apparent angular diameter of $0''.07 \pm 0''.01$. We observe 50 percent linear polarization of the time-averaged power at 196.5 MHz; at 111.5 MHz, 20 percent of the total time-averaged power is polarized, 35 percent of the pulsing power is polarized. The steady component is unpolarized. The total flux of the steady plus pulsating component appears to remain constant while the distribution of power between these components varies. (auth)

9010 POSITION OF OH471. Crowther, J. H. (Royal Radar Establishment, Malvern, Eng.). Nature (London); 243: No. 5401, 25-26(4 May 1973).
Reference is made to Carswell and Strittmatter (Nature 242: 394(1973)) who reported a high redshift for OH 471, but did not quote the accurate radio and optical coordinates which were the basis of the identification of this object. These coordinates are here given. (UK)

9011 LUMINOSITY OF THERMAL X-RAY SOURCES WITH A STRONG MAGNETIC FIELD. Gnedin, Yu. N. (Physical-Technical Inst., Leningrad); Sunyaev, R. A. Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 53-59(1973).
The luminosity of thermal x-ray sources with a strong magnetic field and large optical depth with respect to Thomson scattering $\tau_T > (m_e c^2/\kappa T_e)^{1/2}$ is shown to be many times that of an optically thin source having the same emission measure but radiating due to bremsstrahlung. This increase in luminosity is caused by the Compton process of energy transfer from electrons to photons generated by cyclotron radiation from a hot nonrelativistic magnetized plasma in high ($s \gtrsim 10$) harmonics of the gyrofrequency $\nu = s\nu_H \ll \kappa T_e/h$. A solution of the problem of Compton energy exchange between radiation and magnetoactive plasma is presented. (auth)

9012 GAMMA-RAY EMISSION ABOVE 20 MeV FROM THE CRAB NEBULA AND NP 0532. Parlier, B. (CEN de Saclay, Gif-sur-Yvette, France); Agrinier, B.; Forichon, M.; Leray, J. P.; Boella, G.; Maraschi, L.; Buccheri, R.; Robba, N. R.; Scarsi, L. Nature (London) Phys. Sci.; 242: No. 121, 117-120(23 Apr 1973).
The γ-ray emission from the Crab Nebula was investigated in a series of balloon flights using a multiplate spark chamber trig-

gered by a Cherenkov detector–scintillator coincidence system. Data are reported on the continuum and pulsed γ-ray flux. The spark chamber events analyzed were interpreted as electron–positron pairs generated by γ-ray conversion inside the spark chamber plates. Full details are given of the experimental technique and analytical procedure employed. Consistency of the data suggested that there is a discrete γ-ray source in the Crab direction. It was concluded that a γ-ray flux > 20 MeV was detected from the Crab Nebula direction and that a high proportion of this flux could be attributed to the pulsar NP 0532. The ratio between pulsed and steady flux could only be roughly estimated. The flux values obtained were consistent with extrapolation of the Crab Nebula and NP 0532 energy spectra from the hard x-ray region. (UK)

9013 PERIODICITY OF CYG X-3. Treves, A. (Univ., Milan). Nature (London) Phys. Sci.; 242: No. 121, 121(23 Apr 1973).

The discovery of regular pulsations in the x-ray source Cyg X-3, with a period P ≃ 4.8 hr, was recently reported. This value of P is in between the period of pulsation of pulsars and pulsating x-ray sources and the period of occulation of x-ray sources in a binary system, which supposedly coincides with the period of revolution of the system. If the x-ray source is associated with a neutron star it is difficult to relate P to rotation, since all known pulsars have rotation frequencies many orders of magnitude higher. On the other hand, if the source is a white dwarf, rotation is a natural interpretation of P. The author, however, does not favor a model in which the source of energy is rotation with P = 4.8 hr, on account of the power of Cyg X-3 (10^{37} ergs/sec if the distance is 5 kpc). If accretion through mass transfer between the components of a binary system is considered to be the mechanism of x-ray production, P should be modulated by the period of revolution, which has not been observed. Neither can it be considered that P is the vibration period of a white dwarf, since this vibration has a much shorter time scale. A more plausible interpretation might be that P is the period of revolution of a binary system. An alternative explanation is also discussed, namely that P is the period of percussion of a rapidly rotating neutron star. (UK)

9014 DETECTION OF RY SCUTI AT RADIOFREQUENCIES. Hughes, V. A.; Woodsworth, A. (Queen's Univ., Kingston, Ont.). Nature (London) Phys. Sci.; 242: No. 121, 116-117(23 Apr 1973).

In observations made at 10,500 MHz with the 46m telescope of the Algonquin Radio Observatory the only new source detected was RY Scuti. The source was fairly intense, but showed variability. Because the source is situated in the galactic plane and in a region showing appreciable background emission, single beam scans were taken in both declination and right ascension. A second source, separated from RY Scuti by 4 arc min., was also noted; this is at present unidentified, but could well be an H II region. It is stated that RY Scuti seems to be an object of particular interest. From measurements of the emission lines a mean radial velocity of 30 km/sec was obtained, with no variations, and it has been suggested that the star represents a definite stage in the evolution of certain novae. It has also been suggested that it is an eclipsing variable with a period of 11.1 days. The prominent steady spectral features have been attributed to a shell or ring surrounding a binary system, while the variable lines λ 4026 and 4088 appear to be nonshell lines. If the latter arise from true orbital motion the total mass derived for the system is well in excess of $100M_{\odot}$, indicating one of the most massive binary systems known. The distance has been estimated as ~2 kpc. It is considered that RY Scuti is worthy of further investigation at both radio and optical frequencies. (UK)

9015 OBSERVATIONS OF THE BINARY X-RAY SOURCE SMC X-1 FROM OSO-7. Ulmer, M. P.; Baity, W. A.; Wheaton, W. A.; Peterson, L. E. (Univ. of California, San Diego, La Jolla). Nature (London) Phys. Sci.; 242: No. 121, 121-123(23 Apr 1973).

The results of observation of this source over the period April 15 to May 25, 1972 using the UCSD OSO 7 x-ray telescope are reported. The observations were above 7 keV and complemented the 2 to 6 keV Uhuru satellite results already reported, permitting extension of the spectrum to at least 35 keV. Combined with other observations they could help determine long-term periodic variations, if any exist, and further information about this source is of particular interest because of its high intrinsic luminosity and its recent identification with SK 160. Both the Uhuru and OSO-7 results were compatible with a 3.8927 day period; the spectral shapes were also compatible. Integrating the OSO-7 spectrum from 7 to 35 keV the luminosity of SMC-1 was found to be ~4.5×10^{38} ergs/sec, assuming a distance of 63 Mpc. (UK)

9016 EXCITATION OF ELECTROMAGNETIC RADIATION THROUGH INDUCED COMPTON SCATTERING IN THE NEIGHBORHOOD OF PULSARS. Kaplan, S. A.; Tsytovich, V. N.; Chikhachev, A. S. (Scientific-Research Radiophysics Inst., Moscow). Astrophysics (Engl. Transl.); 6: No. 3, 253-256(1970). Translated from Astrofizika; 6: No. 3, 463-469(1970).

The interaction of relativistic electrons with a high-intensity beam of electromagnetic radiation is discussed. It is shown that, in the case of colliding beams of particles and waves, one can obtain an effective increase in the frequency of the secondary radiation. When the radiation interacts with an isotropically distributed electron cloud the excitation occurs at low frequencies. Numerical estimates are given for a number of pulsar models. (auth)

9017 31.4-GHZ FLUX DENSITY MEASUREMENTS OF VARIABLE RADIO SOURCES. Dent, William A. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002); Hobbs, Robert W. Astron. J. 78: No. 2, 163-169 (Mar 1973).

Measurements of change in flux density with time are presented for 21 sources at 31.4 GHz. The sources, in general, show a higher degree of variability at 31.4 GHz than they do at lower frequencies. The observed relative amplitudes and times of maximum between 31.4 GHz and 7.8 GHz change from outburst to outburst in the very active galaxy 3C 120. This can be interpreted in terms of the expanding source model as being due to capacity differences in the outbursts. (auth)

9018 POLARIZATION OF THE SUPERNOVA REMNANT HB21 AT 11-CM WAVELENGTH. Kundu, M. R.; Becker, R. H.; Velusamy, T. (Astronomy Program, University of Maryland, College Park, Maryland 20742). Astron. J. 78: No. 2, 170-173 (Mar 1973).

Linear polarization at 11-cm wavelength has been detected in the supernova remnant HB21. The degree of polarization varies from about 2% to as much as 20% in some regions. Comparison between the 11- and 6-cm wavelength polarization measurements yields the rotation measure, depolarization, and magnetic field distributions over HB21. Over most of the remnant, the field appears to be the compressed interstellar field. The depolarization at 11 cm is primarily due to the steep gradient of the rotation measure. Large rotation measure appears to occur in regions of enhanced optical emission. (auth)

9019 VELOCITY OF SEPARATION OF THE COMPONENTS OF EXTRAGALACTIC RADIO SOURCES. Mackay, C. D. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 1-9(1973).

Observations of a statistically complete sample of radio sources are used to derive limits to the velocity of separation of the components of typical double radio sources. For the most probable rate of luminosity evolution, the components of a typical source are unlikely to be moving away from the parent galaxy with a velocity exceeding 0.08 c. (auth)

Solar Phenomena

Refer also to abstracts 8905, 9097, and 9316.

9020 (AD-751268) LATITUDINAL MOTION OF SUNSPOTS AND SOLAR MERIDIONAL CIRCULATIONS. Ward, F. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 21 Aug 1972. 27p. (AFCRL-72-499; AFCRL-PSRP-507). NTIS.

There are many theories of the large-scale circulation of the Sun. Fundamental to many of these is a meridional cell which transports momentum between the pole and equator. Observational verification has devolved most often upon the analysis of the latitudinal drifts of sunspots. A comprehensive analysis of sunspot drifts shows some peculiar results. Two conclusions can be drawn from these results. First, sunspot data cannot be used to verify the existence of a mean meridional circulation on the Sun. Second, the residual meridional drifts (averaged over time and longitude) are very much smaller than their day-to-day counterparts, lending support to the idea that the latter are the more fundamental to the large-scale solar circulation. (auth) (NTIS)

9021 (AD-751467) POLAR CAP MEASUREMENTS OF SOLAR FLARE PROTONS WITH ENERGIES DOWN TO 12.4 keV. Report for October 1971–April 1972. Mizera, P. F.; Fennell, J. F.; Blak., J. B. (Aerospace Corp., El Segundo, Calif.). 1 Oct 1972. Contract F04701-72-C-0073. 23p. (SAMSO-TR-72-254). NTIS.

Solar protons with energies down to 12.4 keV were measured over the polar caps by instruments aboard the OV1-17 satellite. The observations were made following the March 21, 1969 solar-

particle event. The polar-cap differential fluxes measured by OV1-17 and Injun-5 from 0.012 MeV to 1.1 MeV are well represented by a single power law. Over a 22 hour period the spectral index changed from 1.7 to 1.9. Temporal and spatial comparisons were made with data from the Explorer-35 and Injun-5 spacecraft. Good agreement was found at energies (>300 keV) where a comparison can be made. (auth) (NTIS)

9022 (AD-751909) INTERPLANETARY SECTOR STRUCTURE AND THE HELIOMAGNETIC EQUATOR. Report of January 1971–June 1972. Schulz, M. (Aerospace Corp., El Segundo, Calif.). 10 Nov 1972. Contract F04701-72-C-0073. 27p. (SAMSO-TR-72-262). NTIS.

The magnetohydrodynamics of solar-wind flow lead logically to the formation of one warped annular neutral surface that extends from about twenty solar radii to the boundary of the heliosphere. The most likely asymptotic configuration for this neutral sheet intersects the heliomagnetic equatorial plane along four corotating arcs. The observer sees a reversal of magnetic polarity on each crossing of the neutral surface, and so interprets each reversal as the crossing of a sector boundary. (auth) (NTIS)

9023 (AD-751925) FORECASTING PEAK PROTON FLUX AND PCA EVENT MAGNITUDES USING "FLASH-PHASE" INTEGRATED RADIO-BURST FLUX DENSITY. Newell, D. T. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 23 Aug 1972. 32p. (AFCRL-72-543; AFCRL-ERP-415). NTIS.

A new parameter is introduced for use in forecasting the magnitudes of solar proton and polar cap absorption events. Semi-integrated flux density is the integrated radio flux density under the start-to-maximum burst curve. An approximation to this function was correlated at five operational frequencies against both observed peak proton flux and observed riometer absorption, obtaining correlation coefficients > or = 0.88 at frequencies between 2695- and 8800-MHz. An operational real-time forecast scheme is detailed for the solar forecaster. Results from this study, which uses peak proton fluxes both corrected and uncorrected for solar disk positions, indicate that forecasts have a higher degree of correlation with observations if propagation corrections are not applied as present methods dictate. When used in conjunction with the Castelli "U" burst spectrum criteria for forecasting the occurrence of proton events, radio data can be used exclusively for both a yes/no and an event magnitude forecast. A comparison with the method presently in use at the Air Weather Service's Aerospace Environmental Support Center, Solar Forecast Branch is made with very favorable results. (auth) (NTIS)

9024 (AD-752230) THEORETICAL STUDIES IN SUNSPOTS AND ASSOCIATED STRUCTURES. Final Report, 26 January 1970–26 July 1972. Wyller, A. A.; Yun, H. S. (Bartol Research Foundation, Swarthmore, PA). 4 Aug 1972. Contract F19628-70-C-0192. 50p. (AFCRL-72-466). NTIS.

A numerical application to the extreme cases of high and low degree of ionization of the binary collision theory of Burgers (1960) and the multiple collision theory of Shkarofsky (1960) shows very good agreement in the values of the magnetic tensor components for solar electrical conductivity. It is pointed out that the inclusion of ion motions in Burgers theory favors its use in the future evaluation of the solar thermal conductivity tensor. The work of Ulmschneider (1970) on the effective thermal conductivity of partially ionized plasmas has been generalized to include the effects of magnetic fields. The contributions of electron, ion, and neutral heat flows were evaluated within the framework of the binary collision theory of Burgers (1960). (auth) (NTIS)

9025 (BNL-tr-538) PROBLEM OF SOLAR NEUTRINOS. Shchepkin, M. G. Translated by S. J. Amoretty from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 4, 226-229(1973). 9p. Dep. NTIS $3.00.

A mechanism is considered which would explain the low counting rates for solar neutrinos. Temperature fluctuations in the solar interior may cause the neutrino luminosity to change sharply with time while the photon luminosity remains essentially constant due to the large time lag of diffusion (2 to 3×10^4 years). (WDM)

9026 (N-73-14807) MIT SOLAR WIND PLASMA DATA FROM EXPLORER 33 AND EXPLORER 35: JULY 1966 TO SEPTEMBER 1970. Howe, H.; Binsang, J.; Wang, C.; Clapp, E. (Massachusetts Inst. of Tech., Cambridge. Center for Space Research). Dec 1971. Contract NAS5-9078. 40p. (NASA-CR-129923; CSR-TR-71-4). NTIS.

The plasma experiments on Explorer 33 and Explorer 35 have yielded large amounts of solar wind data. This report gives a brief review of the method used to obtain the data, provides a description of the plasma parameters, and describes in detail the format of the plots and tapes which are available from the Data Center. Hourly average plots of the data are included at the end of the report. From these plots, the availability and interest of the solar wind data for any period of time may be determined. (auth) (STAR)

9027 (N-73-16793) EXPERIMENTAL STUDY OF SPECTRAL AND SPATIAL DISTRIBUTION OF SOLAR X RAYS. Final Report. Acton, L. W.; Catura, R. C.; Culhane, J. L. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). 29 Sep 1972. Contract NASw-1834. 74p. (NASA-CR-130359; LMSC-D-309802). NTIS.

The study of the physical conditions within the solar corona and the development of instrumentation and technical expertise necessary for advanced studies of solar x-ray emission are reported. Details are given on the Aerobee-borne-x-ray spectrometer/monochromator and also on the observing program. Preliminary discussions of some results are presented and include studies of helium-like line emission, mapping O(VII) and Ne(IX) lines, survey of O(VII) and Ne(IX) lines, study of plage regions and small flares, and analysis of line emission from individual active regions. It is concluded that the use of large-area collimated Bragg spectrometers to scan narrow wavelength intervals and the capability of the SPARCS pointing control to execute a complex observing program are established. (STAR)

9028 (N-73-16797) NUCLEAR GAMMA RAYS FROM SOLAR FLARES. Ramaty, R.; Lingenfelter, R. E. (National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center). Jan 1973. 29p. (NASA-TM-X-66165; X-660-73-14). NTIS.

The theory of gamma-ray line emission from solar flares is reviewed and revised. It is shown that the recently observed (Chupp et al., 1972) line emissions at 0.5, 2.2, 4.4, and 6.1 MeV are due to positron annihilation, deuterium deexcitation following neutron capture on hydrogen, and the deexcitation of excited states in carbon and oxygen. From the observed relative line intensities it is possible to determine the spectrum of accelerated protons in the flare region. This spectrum is found to be very similar to that of the charged particles from the flare observed near Earth. The total numbers of protons at the Sun is deduced from the observed absolute line intensities for various interaction models. It is found that if the protons at the Sun have a spectrum which is an exponential in rigidity, the total energy in protons is a few times 10^{28} ergs if the gamma rays are produced by protons moving down into the Sun; and about 10^{30} ergs if the gamma rays are produced at the site of the acceleration. (auth) (STAR)

9029 (TRITA-EPP-73-5) DOUBLE LAYERS AND TWO-STREAM INSTABILITY IN SOLAR FLARES. Carlqvist, P. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Feb 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The formation of electrostatic double layers in plasmas is considered in connection with a theory of solar flares. Laboratory experiments on current interruption and double layers are reviewed. An evacuation mechanism which may lead to the formation of double layers in the solar atmosphere is discussed. The evacuation mechanism is shown to be intimately related to the two-stream instability. The evacuation starts when the current density in the plasma exceeds the critical limit for the two-stream instability. (auth)

9030 IS THE SOLAR SYSTEM GRAVITATIONALLY CLOSED? Bertotti, B. (Oxford Univ.). Astrophys. Lett., 14: No. 1, 51-53(1973).

A cosmological spectrum of gravitational waves produces a random walk in the orbital elements of a planet or a satellite. Upper limits to the spectral density at the revolution frequencies can be established in this way; in particular, the lunar laser-ranging experiment provides interesting information which, however, is not yet precise enough to be cosmologically relevant. The opportunity of taking this effect into account in analyzing future experiments is stressed. (auth)

9031 SOLAR NEUTRINOS AND A CENTRAL MAGNETIC FIELD IN THE SUN. Chitre, S. M.; Ezer, D.; Stothers, R. (Goddard Inst. for Space Studies, New York). Astrophys. Lett.; 14: No. 1, 37-40(1973).

A strong, centrally concentrated magnetic field in the Sun could explain, at least in part, the low solar neutrino flux observed by Davis. (auth)

9032 SCATTERING EFFECTS ON THE RELATIVE POSITIONS AND INTENSITIES OF FUNDAMENTAL AND HARMONIC EMISSION OF SOLAR RADIO BURSTS. Leblanc, Y. (Observatoire de Meudon, France). Astrophys. Lett.; 14: No. 1, 41-45 (1973).

The effect of coronal inhomogeneities on the fundamental (F) and harmonic (H) radiation of Type-II and Type-III radio bursts was computed at 30 MHz (30F) and 60 MHz (60H), in the case when

the two emissions originate from the same region, and at 60 MHz (60F and 60H) for the two emissions originating from two different levels. In the first case the apparent position of the harmonic lies closer to the center of the solar disk than the apparent position of the fundamental. In the second case the apparent position of the fundamental coincides with that of the harmonic. Furthermore, the attenuation due to scattering of the fundamental is higher than that of the harmonic, especially near the limb position. These results are compared with observations. (auth)

9033 CALCULATION OF THE PERIHELION ADVANCE OF PLANETS IN A FIELD APPROACH TO GRAVITATION. Majernik, V. (Inst. of Physics, Bratislava). Astrophys. Space Sci.; 15: No. 3, 375-382(Mar 1972).

It is shown that, when taking into account the self-gravity of field energy of a gravitational field, one obtains a modified field equation for the intensity of gravitational field, the solution of which, when inserted in Kepler's problem, furnishes a formula for the perihelion precession of planets which (except for a fitting numerical factor) is identical with Einstein's. The significance of an analogous equation in electrodynamics is pointed out and an attempt is made to construct a field model within relativistic field theory which justifies the previous perihelion-shift calculation. (auth)

9034 DEFLECTION OF LIGHT AT THE SUN AND ITS CHANGE OF VELOCITY AND WAVELENGTH. Thuering, B. (Forschungsbuero fuer Theoretische Astronomie, Karlsruhe, Ger.). Astrophys. Space Sci.; 15: No. 3, 467-478(Mar 1972). (In German).

Shapiro (1968) published the first results of radar-echo-observations on Venus and Mercury in the neighborhood of upper conjunctions with the Sun; the observations indicate a decrease of the velocity of light passing the Sun. The theory of Soldner is disproved; and the general relativity is in accord with the observed facts. But not this theory alone. The deflection of light, decrease of the velocity of light, and displacement of spectral-lines are explained with the aid of a wavetheory. Hereby the assumption of a material medium carrying light-waves is sufficient, the density of which is below that of the empirical vacuum; hence, the medium must have a small inhomogeneity h radial to the Sun, and the Maxwell equations contain small additional terms. They lead to the field equations. The protophysical fundamentals of the wave-theory lead to the equations of wave-phase. If it is assumed that the behavior of the light passing the Sun is independent (in first approximation) from the wave-form, the equation of wave-phase, is deduced for simple-periodic waves of light. The slope and deflection of the ray of light by the Sun are outlined. The constant of inhomogeneity $\delta = \frac{1}{4}10^{-5}$ (of the radius of the Sun) produces a deflection of light passing the Sun. The length of waves of the light approaching the Sun is decreased to a minimum and is increasing with increasing distance from the Sun. The velocity of light approaching the Sun is decreased to a minimum and increases with increasing distance from the Sun. (auth)

9035 PRECISION MEASUREMENT OF THE SUN'S GRAVITATIONAL FIELD BY MEANS OF THE TWIN PROBE METHOD. Bertotti, B. (Univ., Pavia, Italy); Colombo, G. Astrophys. Space Sci.; 17: No. 1, 223-237(Jul 1972).

An accurate measurement of the gravitational field of the Sun, needed for the verification of the theories of gravitation, requires the use of a geodesic test body. To eliminate the effect of nongravitational forces (mainly the solar radiation pressure) it is proposed to use two twin space probes, whose surface has identical geometrical and optical properties, but with different mass. Their differential motion leads to the determination of the motion of an ideal geodesic point. The various conditions which are needed to ensure the required degree of identity are discussed and two cylindrical probes, whose sides are covered by 'cavities' to make them absorbing, rotating at a fast rate around an axis orthogonal to the ecliptic plane are submitted as a possible solution. The accuracy in the determination of the parameters of the metric field of the Sun obtainable from range measurements is briefly discussed. (auth)

9036 NUMERICAL SIMULATION OF JETSTREAMS. I. The Three Dimensional Case. Trulsen, J. (Univ. of Tromsoe, Norway). Astrophys. Space Sci.; 17: No. 1, 241-262(Jul 1972).

The dynamics of jetstreams have been studied by following the evolution of a simulation particle population. The self-gravitational field of the stream has been neglected, the individual small bodies interacting through hard, partially inelastic collisions only, no fragmentation or accretion taking place. The chosen collision model—the beta-model—is given. The collisions will quickly establish a Rayleigh distribution of both eccentricities and inclinations, the average amplitude of the oscillations associated with eccentricity being up by approximately a factor $\sqrt{2}$. The velocity distribution inside the stream is highly non-Maxwellian. If the collisions are sufficiently inelastic, the stream is focused, the individual orbits becoming more and more circular (for azimuthally symmetric streams) and ecliptic. In the opposite case the collisions destroy the stream configuration rapidly. The beta collisional model is unable to produce any radial focusing. (auth)

9037 CHEMICAL FRACTIONATIONS IN METEORITES. 7. Cosmothermometry and Cosmobarometry. Larimer, J. W. (Arizona State Univ., Tempe). Geochim. Cosmochim. Acta; 37: No. 6, 1603-1623(Jun 1973).

The fractional condensation of Bi, Cd, In, Pb, and Tl from a cooling gas of cosmic composition is calculated. Predicted absolute and relative abundances of the elements are in good to excellent agreement with the analytical data. This strongly suggests that the presently observed abundances were established at the time of accretion. There is no need to invoke nonequilibrium during condensation or element redistribution after accretion to explain the observations. The elements may therefore be used as cosmothermometers to predict accretion temperatures. Calculated accretion temperatures fall in the range 420 to 540°K. But a large percentage of each chondrite (H, L, LL, and E) fall within much narrower intervals, ≤ 20°K. This implies that the bulk of each group accreted over a narrow temperature range which is consistent with their uniform oxidation states and O^{18}/O^{16} ratios. In fact, temperature inferred from the oxidation state and oxygen isotopes are in excellent agreement with the trace element data. The condensation curves of all these elements are pressure-dependent but are confined to fall in the temperature interval 400 to 600°K owing to the absence of Fe_3O_4 and the presence of FeS in ordinary chondrites. Absolute upper and lower limits on the total pressure can thus be deduced; 10^{-3} to 10^{-6} atm. In addition, the condensation curves for Bi and In cross over at T = 462°K and $P_t = 2 \times 10^{-5}$ atm. The observed relative abundances of Bi and In suggest the L-group formed at slightly lower and the H-group at slightly higher P and T. (auth)

9038 EMPIRICAL CLOSURE RELATION FOR THE VLASOV MOMENT EQUATIONS. Feldman, W. C.; Asbridge, J. R.; Bame, S. J.; Lewis, H. R. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). Phys. Rev. Lett. 30: No. 7, 271-274 (12 Feb 1973).

Empirical statistical relationships are found between each of the third moments and the two second moments of solar-wind proton velocity distributions. These can be used to close the Vlasov moment equations when applied to the behavior of the solar-wind plasma over a sufficiently large temporal or spatial scale. (auth)

9039 FLOCCULE THEORY FOR PLANETARY FORMATION. Williams, I. P. (Queen Mary Coll., London). Astrophys. Space Sci.; 18: No. 1, 223-225(Sep 1972).

The accumulation of floccules into protoplanets is discussed, and it is pointed out that the simplifications which have been introduced into recent numerical models may result in the incorrect conclusion being reached. (auth)

9040 DIRECT SIMULATION OF COLLISION PROCESSES. Dodd, R. J. (Royal Observatory, Edinburgh); Napier, W. M.; Preece, A. A. Astrophys. Space Sci.; 18: No. 1, 196-206.

A Monte Carlo technique for examining the mass distribution of mutually colliding bodies is described. The technique is simple to program and can handle a wide variety of physical circumstances. Some illustrative cases are given. (auth)

9041 POSSIBILITY OF DETECTING WEAK SOLAR-COSMIC-RAY FLUXES BY GROUND-BASED RADIO METHODS. Driatskii, V. M.; Shirochkov, A. V. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 715-719(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 823-829(1972).

The sensitivity is estimated of several radio methods of investigating the ionosphere to effects produced by weak solar cosmic-ray fluxes injected into the polar atmosphere of the Earth. An estimate is also made of the sensitivity of some radio methods for detecting solar cosmic-ray fluxes at night. (auth)

9042 EFFECT OF IONIZATION LOSSES ON COSMIC-RAY GENERATION CONDITIONS ON THE SUN. Velinov, P. (Geophysical Inst., Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 700-706(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 806-813(1972).

The conditions under which particles are accelerated in the solar atmosphere are investigated. Particle energy losses due to ionization and their effect on various acceleration mechanisms on the Sun are analyzed. (auth)

9043 SPECTRUM OF SMALL-SCALE INTERPLANETARY PLASMA INHOMOGENEITIES. Lotova, N. A.; Chashey, I. V. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 695-699(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 800-805(1972).

It has been established that the observed variations in the size of the diffraction pattern of interplanetary scintillations α_{eff} with changing angular distance of the transmitting source from the Sun ϵ^0 describe the variations in the scale of inhomogeneities. A comparison of the observed with the computed $\alpha_{eff}(\epsilon^0)$ suggests that the exponent in the energy spectrum of inhomogeneities ranges from zero to unity. The difference between the effective dimensions of inhomogeneities in scattering and scintillation effects may reach ~10 in some regions of ϵ^0. (auth)

9044 LARGE VELOCITY DISCONTINUITIES IN THE SOLAR WIND. Burlaga, L. F. (Goddard Space Flight Center, Greenbelt, MD). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 693-694(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 797-799(1972).

Recently, Ivanov (1970) showed that an interesting new kind of discontinuity, which he called "rotational," might exist in an anisotropic medium, and he stated that 10 of the 11 discontinuities in Burlaga (1969) must be of this new type. It is shown that 5 of those discontinuities are not "rotational." The recent work by Hudson (1970, 1971) is used to show that most of the discontinuities in Burlaga (1969) are probably not rotational discontinuities in the more familiar sense of the word. (auth)

9045 NUMERICAL SIMULATION OF JETSTREAMS. II. The Two Dimensional Case. Trulsen, J. (Univ. of Tromsoe, Norway). Astrophys. Space Sci.; 18: No. 1, 3-20(Sep 1972).

The dynamics of two dimensional jetstreams were studied by following the evolution of simulation particle populations for different collision models. Collisions, independent of details of the collision model, rapidly lead to the establishment of a distribution of perihelion vectors of the form $\sim\exp(-\alpha(P-\eta)^2)$, the characteristic time for this process being of the order of magnitude equal to the mean free collision time. Under appropriate conditions a radial focusing takes place. In terms of the varians of semi-major axis a focusing exceeding a factor 2 was achieved. Necessary conditions for the existence of this radial focusing are a sufficient degree of inelasticity and the requirement that the dominant part of the velocity change in a typical collision is along the pre-collisional relative velocity vector. The properties of grazing collisions are especially important in this respect. (auth)

9046 ELECTROSTATIC ION CYCLOTRON WAVES IN AN ANISOTROPIC PLASMA. Vithal, K. L.; Tandon, J. N. (Univ. of Delhi). Astrophys. Space Sci.; 18: No. 1, 49-58(Sep 1972).

In the solar wind, electrostatic ion cyclotron waves can be excited by electrons or ions when the flow velocity becomes supersonic. The instability of these waves is investigated for a situation in which ions are streaming in opposite directions along the interplanetary magnetic field in a uniform background of relatively stationary electrons. Many modes become unstable under the existing conditions. It is conjectured that the excitation of this instability may lead to a steady-state electrostatic turbulence in the solar wind. (auth)

9047 ANALYSIS OF THE NON-GAUSSIAN SPECTRA OF INTERPLANETARY SCINTILLATIONS. Alurkar, S. K.; Sarker, R. P.; Rao, V. B. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brasil). Astrophys. Space Sci.; 19: No. 2, 271-278(Dec 1972).

The non-Gaussian intensity fluctuation spectra observed by Cohen et al. (1967) were analyzed. Computations of the length scales derived from the phase autocorrelation functions using Buckley's method (1971, I) indicated that for a rms phase deviation of 4 radians or more the diffracting medium behaves as one with its phase structure having "inner" and "outer" scales of turbulent blobs or eddies which are present in a turbulent medium. (auth)

9048 THERMALIZATION OF SOLAR WIND. Krishan, S.; Rankin, D. (Univ. of Alberta, Edmonton, CA). Astrophys. Space Sci.; 19: No. 1, 207-217(Nov 1972).

Three kinetic equations describing the linear and nonlinear wave-particle interaction for an anisotropic solar wind plasma were developed. These equations were solved numerically to find the variation in $T_\perp/T_\parallel$ with respect to time, where $T_\perp$ and $T_\parallel$ are the perpendicular and parallel temperatures with respect to the ambient magnetic field of the solar wind. For wave energy greater than a critical value (strong turbulence), nonlinear wave-particle interactions are important but do not lead to thermalization. On the other hand, weak nonlinear interactions tend to increase $T_\perp/T_\parallel$, but make only a negligible contribution in the quantitative sense. Thus, only the linear wave-particle interaction remains as the significant contributer to the increase of $T_\perp/T_\parallel$. (auth)

9049 FINE STRUCTURE IN THE SOLAR CHROMOSPHERE. Liu, S. Y. College Park, MD; Univ. of Maryland (1972). 125p. University Microfilms Order No. 73-11,402.

Thesis (Ph. D.).

A set of simultaneous Ca II K-line spectrograms and K_{2v} spectroheliograms was obtained to make an unambiguous identification of features which emit specific K-line profile shapes. About 20% of the area of the quiet chromosphere is covered by dark regions, while the rest is occupied by network fragments, cell points and faint emission patches. The network, composed of several pieces of loosely connected bright fragments, becomes apparent at a height of about 200 km below the temperature minimum, extends through the temperature minimum and the chromosphere, and is still apparent in the lower corona. The intensity of the chromospheric network oscillates with a 300 sec period, while that of the photospheric counterpart fluctuates irregularly. The properties of the cell points, which are best visible at K_2, were determined. Time sequence spectrograms reveal that the intensity variation at K_2 is intrinsic. A qualitative model with three components, i.e., network, dark region and cell point, is inferred under the guideline of the Harvard-Smithsonian Reference Atmosphere. The network has a relatively high value of the minimum temperature; moreover, it occurs at a low layer and has a steep temperature rise in the chromosphere. On the other hand, the dark region has a lower value of the minimum temperature and a less steep temperature rise. The temperature profile of the cell point must be between these two extremes. (TSS)

9050 TIME DIFFERENCES IN THE FORMATION OF METEORITES AS DETERMINED FROM THE RATIO OF LEAD-207 TO LEAD-206. Tatsumoto, M. (Geological Survey, Denver); Knight, R. J.; Allegre, C. J. Science; 180: No. 4092, 1279-1283(22 Jun 1973).

Measurements of the lead isotopic composition and the uranium, thorium, and lead concentrations in meteorites were made in order to obtain more precise radiometric ages of these members of the solar system. The newly determined value of the lead isotopic composition of Canyon Diablo troilite is as follows: $^{206}Pb/^{204}Pb$ = 9.307, $^{207}Pb/^{204}Pb$ = 10.294, and $^{208}Pb/^{204}Pb$ = 29.476. The leads of Angra dos Reis, Sioux County, and Nuevo Laredo achondrites are very radiogenic, the $^{206}Pb/^{204}Pb$ values are about 200, and the uranium-thorium-lead systems are nearly concordant. The ages of the meteorites as calculated from a single-stage $^{207}Pb/^{206}Pb$ isochron based on the newly determined primordial lead value and the newly reported ^{235}U and ^{238}U decay constants, are 4.528×10^9 years for Sioux County and Nuevo Laredo and 4.555×10^9 years for Angra dos Reis. When calculated with the uranium decay constants used by Patterson, these ages are 4.593×10^9 years and 4.620×10^9 years, respectively, and are therefore 40 to 70×10^6 years older than the 4.55×10^9 years age Patterson reported. The age difference of 27×10^6 years between Angra dos Reis and the other two meteorites is compatible with the difference between the initial $^{87}Sr/^{86}Sr$ ratio of Angra dos Reis and that of seven basaltic achondrites observed by Papanastassiou and Wasserburg. The time difference is also comparable to that determined by $^{129}I-^{129}Xe$ chronology. The ages of ordinary chondrites (H5 and L6) range from 4.52 to 4.57×10^9 years, and, here too, time differences in the formation of the parent bodies or later metamorphic events are indicated. Carbonaceous chondrites (C2 and C3) appear to contain younger lead components. (auth)

9051 DISCONTINUOUS CHANGE IN EARTH'S SPIN RATE FOLLOWING GREAT SOLAR STORM OF AUGUST 1972. Gribbin, J.; Plagemann, S. Nature (London); 243: No. 5401, 26-27(4 May 1973).

The possibility of a link between changes in the Earth's spin rate and the activity of the Sun is of interest, and there is evidence that the changing length of day is influenced by the mean level of solar activity. During the great solar storm in August 1972 a discontinuous change in the length of day was found, together with a change in the rate of change immediately after that event. Changes in the length of day, and thus in the spin rate of the Earth, are shown by the regular measurements of Universal Time carried out at many observatories around the world. Data are shown plotted for a period of one month on either side of the great solar storm. (UK)

9052 ASYMPTOTIC BEHAVIOUR OF A KINETIC SOLAR WIND MODEL. Lemaire, J.; Scherer, M. (Institut d'Aeronomie Spatiale de Belgique, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 58: 1112-1134(1972). (In French).

In this solar-wind model, the Coulomb collisions, with impact parameter smaller than the Debye length, have been neglected beyond the baropause located at 6.6 solar radii. The radial distri-

bution of the electric potential is calculated in order to satisfy the local and global quasineutrality conditions in the whole exospheric plasma. The asymptotic behavior for large radial distances as well as in the neighborhood of the baropause has been calculated and discussed. It has been deduced that the electric field distribution near the baropause does practically not influence the properties at 1 AU. A simple relationship between the coronal temperature and solar-wind velocity at large distances has been found; the kinetic plasma pressure is found to decrease asymptotically to zero as $r \to \infty$: the parallel and perpendicular temperatures of the protons satisfy the "adiabatic approximation" of Chew, Goldberger, and Low in the most external regions ($r > 100\ R_s$). The use of this approximation between 6 to 7 R_s and 100 R_s would give a 250% underestimation of the parallel proton temperature compared to the present model calculation. (auth)

9053 MECHANISM FOR THE PRODUCTION OF LIGHT AND DARK CONTRASTS IN RADIATIVELY CONTROLLED LINES. Gebbie, K. B.; Steinitz, R. (Joint Inst. for Lab. Astrophysics, Boulder, CO). Solar Phys.; 29: No. 1, 3-15(Mar 1973).

It is argued that visible contrasts can arise even in a line that is controlled wholly by an external radiation field. Lateral differences in the local shapes of the line absorption profile are shown to account for such contrasts. Two cases are treated explicitly: (a) a profile locally broadened by mass flow, and (b) a profile locally narrower due to the suppression of turbulent velocities, as might result from the presence of magnetic fields. (auth)

9054 PROPOSED CORRECTION TO THE SOLAR ABUNDANCES OF CARBON AND OXYGEN UTILIZING NEW AND ACCURATE THEORETICAL FORBIDDEN TRANSITION PROBABILITIES. Nicolaides, C. A.; Sinanoğlu, O. (Yale Univ., New Haven). Solar Phys.; 29: No. 1, 17-22(Mar 1973).

Previously published solar abundances of oxygen and carbon can be corrected to be log N(O) = 8.93 and log N(C) = 8.60 on the hydrogen log-scale when new accurate forbidden electric quadrupole transition probabilities $A_Q(s^{-1})$ are used. Such A_Q's, based on the new atomic structure and electron correlation theory, developed recently by Sinanoğlu and coworkers, are reported for the $(^1S_0 - {}^1D_2)$ lines of $[C_I]$, $[N_{II}]$, $[O_I]$, and $[O_{III}]$ and the $(^2P - {}^2D)$ lines of $[N_I]$ and $[O_{II}]$. The available experimental values are also given for comparison. (auth)

9055 STUDIES OF THE SOLAR CHROMOSPHERE FROM MILLIMETRE AND SUB-MILLIMETRE OBSERVATIONS. I. Isophotometric Mapping. Beckman, J. E.; Clark, C. D. (Queen Mary Coll., London). Solar Phys.; 29: No. 1, 25-39(Mar 1973).

Spectroheliograms were obtained in bands centered at 1.2 mm, 0.8 mm, and 0.4 mm wavelength during 1969 and 1971. In order to obtain photometrically valid data, a specialized set of reduction techniques was employed, obviating the effects of severe differential attenuation across the disc by atmospheric water vapor and of emission noise from the atmosphere, before taking out the instrumental spread functions of the telescope and detector. Comparison of the maps with those of other observers at 3 mm and 8.6 mm wavelength suggests that the chromospheric brightness temperature increments above active regions show a monotonic increase with increasing height above the photosphere over the normal increase in brightness temperature in the quiet chromosphere. Within the limit of angular resolution of 3′ available, no evidence was recorded of normal limb brightening in the three passbands but the presence of isophotes at 50% of the central disc temperature consistently circumscribing the optical limb implies a narrow spike of sub-millimetre brightening close to the limb. (auth)

9056 OBSERVATIONS OF THE INNER F AND K CORONAS BELOW λ2220. Orrall, F. Q.; Speer, R. J. (Univ. of Hawaii, Honolulu). Solar Phys.; 29: No. 1, 41-46(Mar 1973).

The inner coronal continuum has been observed and measured below λ2220 on the slitless spectra obtained by Speer et al. (1970) at the March 7, 1970 eclipse. These observations set some constraints on the brightness of the inner F corona and hence on the scattering efficiency of the inner interplanetary dust cloud particles in the far ultraviolet. They neither confirm nor reject the possibility that the inner dust cloud has the same sharp upturn in scattering efficiency below λ2000 observed in the zodiacal light and in the interstellar medium. (auth)

9057 SHORT PERIODICITIES IN SOLAR ACTIVITY. Rao, K. R. (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil). Solar Phys.; 29: No. 1, 47-53(Mar 1973).

Several indices of solar activity are subjected to a high-pass filter and power spectral analysis to verify the existence of shorter periodicities in solar activity. Though all these indices show the presence of short periodicities, above 95% confidence level, the common indices like sunspot number, fail to show these periodicities when a stringent statistical test is applied based on a percentage of the χ^2/ν distribution that is appropriately higher than the 95% point (Mitchell et al., 1966). The basic parameters given by Kopecky (1967), however, reveal the presence of 5.6- and 3.5-yr periodicities even when this stringent statistical test is applied. (auth)

9058 MORPHOLOGICAL AND KINEMATICAL STUDY OF FINE STRUCTURE OF SUNSPOTS. Muller, R. (Fraunhofer Institut, Freiburg I. B.). Solar Phys.; 29: No. 1, 55-73(Mar 1973). (In French).

A sequence of 34 photographs of the main spot of the group H 26 (Daily Maps of the Sun, Freiburg 1970, Rome number 5847) was obtained with the 38 cm refractor of the Pic-du-Midi Observatory, showing throughout a resolution very close or equal to 0.3″. An interval of 3 hr is covered. The pictures taken at intervals of 6 min approximately permit to study the fine structure of the penumbra and associated phenomena. (WDM)

9059 SPECTRAL ANALYSIS OF SUNSPOT FLARES. Machado, M. E.; Seibold, J. R. (Observatorio Nacional de Fisica Cosmica, San Miguel, Argentina). Solar Phys.; 29: No. 1, 75-92 (Mar 1973).

In the H and K lines spectral region, 31 flares covering part of umbrae or penumbrae of sunspots were qualitatively analyzed. A strong narrowing of the emission lines was observed over the umbrae, and the lines were, in general, much weaker than in common flares suggesting that the optical thickness was quite low in these parts. The Stark broadening of the Hε line was calculated from the general theory, and it was applied to obtain the electron density in 9 flare spectra. In all cases it was found that $n_e > 10^{13}\ cm^{-3}$. Goldberg's method was applied to find the kinetic temperature from the H and K lines of Ca II, and from the ratio between the central intensities of the lines the optical thickness in the K line was calculated. Much evidence supports the assumption that the flare emission is highly diluted in the cases considered, and a two-component model for the calcium emission lines is proposed. (auth)

9060 NONTHERMAL IONIZATION AND RECOMBINATION PROCESSES DURING SOLAR FLARES. Landini, M.; Monsignori Fossi, B. C.; Pallavicini, R. (Arcetri Astrophysical Observatory, Florence). Solar Phys.; 29: No. 1, 93-105(Mar 1973).

Ionization and recombination processes were studied for a plasma of which the electrons follow a power-law energy distribution. The rates for collisional ionization, radiative and dielectronic recombination, and for autoionization were evaluated. Numerical computations were performed for H-like, He-like, and Li-like ions from neon to nickel as a function of the spectral index of the electron distribution. The ionization equilibrium was evaluated as well as the ratios of fluxes emitted in two lines pertaining to two successive ionization stages of the same element. A comparison with a few experimental data was made and the possibility of a nonthermal interpretation of x-ray line emission during solar flares is discussed. (auth)

9061 EXTREME ULTRAVIOLET EMISSIONS OF SOLAR FLARES: A COMPARISON BETWEEN OSO-6 SPECTROHELIOGRAPH OBSERVATIONS AND SFDs. Donnelly, R. F. (National Oceanic and Atmospheric Administration, Boulder, CO); Wood, A. T. Jr.; Noyes, R. W. Solar Phys.; 29: No. 1, 107-123(Mar 1973).

The time structure and intensity of OSO-6 observations of euv bursts were studied in relation to the corresponding 10 to 1030 Å enhancements deduced from SFD data. Impulsive euv emissions from lines normally emitted from either the chromosphere or from the chromosphere–corona transition region rise simultaneously with the 10 to 1030 Å flash, to within the time resolution of the OSO-6 observations. Mg x 625Å also showed concurrent impulsive emissions and a close intensity relation to the 10 to 1030 Å enhancement. The observational results are consistent with the hypothesis that most of the euv radiation is being produced thermally in a region of chromospheric density, which is being heated by collisional losses of nonthermal electrons. (auth)

9062 SPECTRA OF SOLAR FLARES FROM 8.5 Å TO 16 Å. Doschek, G. A. (Naval Research Lab., Washington, DC); Meekins, J. F.; Cowan, R. D. Solar Phys.; 29: No. 1, 125-141(Mar 1973).

X-ray spectra of solar flares in the spectral range from 8.5 to ~16 Å have been obtained from a Naval Research Laboratory crystal spectrometer flown on the sixth Orbiting Solar Observatory (OSO-6). A list of emission features is presented and tentative identifications of some of the features are suggested. The time-behavior of the emission lines during flares is discussed, and the possibility of determining electron densities in flare plasmas

using density sensitive lines of highly ionized iron is considered. Approximate calculations are performed for a density sensitive line of Fe XXII. (auth)

9063 SOLAR ALBEDO OF HARD X-RAY FLARES. Santangelo, N.; Horstman, H.; Horstman-Moretti, E. (CNR, Bologna). Solar Phys.; 29: No. 1, 143-148(Mar 1973).

The calculations of Compton backscattering from the solar surface of flare x rays performed by Tomblin (1972) are extended to higher energies. It is shown that the effect is even more pronounced in the 40 keV region and that it can lead to substantial corrections to the observed x-ray spectra. (auth)

9064 NONEXISTENCE OF LINEAR POLARIZATION IN TYPE III SOLAR BURSTS AT 80 MHz. Grognard, R. J. M.; McLean, D. J. (CSIRO, Sydney). Solar Phys.; 29: No. 1, 149-161(Mar 1973).

A search for linear polarization showing the effect of Faraday rotation was made at 80 MHz in Type III solar radio bursts. A novel autocorrelation technique was employed. The results were entirely negative, contrary to what was expected on the ground of earlier, less sophisticated experiments. However, there are convincing theoretical reasons why no linear polarization should be expected. (auth)

9065 SOME TRANSIENT Hα FEATURES ASSOCIATED WITH METRIC TYPE III BURSTS. Axisa, F. (CEN, Saclay, France); Martres, M. J.; Pick, M.; Soru-Escaut, I. Solar Phys.; 29: No. 1, 163-182(Mar 1973).

The question of the chromospheric features Type III associations was reconsidered by using Hα filtergrams both on and off band. A set of 44 metric Type III groups, for which an association could be ascertained with a high degree of confidence lead to the following results: (1) The Type III's have a dual chromospheric association. Sometimes they are related to a flare, sometimes to a perturbation of a different kind. The latter is seen in absorption in the Hα core and ±0.75 Å away. It is interpreted as a rather dense and cool material in motion in the chromosphere or the low corona. A part of which moves downward, the other upward. The Type III's are more closely related to the downward motion. (2) The Type III associated absorbing features take place at the border of an active center and along an $H_{\parallel} = 0$ line. At the present time this appears as the most conspicuous property for marking them off from the great variety of the Hα absorbing features commonly observed on the Sun. (3) Most of the Type III associated flares are related to an absorbing feature of the same kind, which appears before the flare itself. This indicates that the initial instability which is responsible for the Type III emission is basically the same, whether the bursts are flare associated or not. The observations give good evidence that an efficient acceleration of 10- to 100-keV electrons occur also in the absence of flares. Furthermore the chromospheric perturbation involved in this acceleration is, in many cases, clearly associated to the triggering of a flare. A tentative model is proposed. It is assumed that in relation with the Hα absorbing feature a stream of fast electrons is accelerated which in turn, under suitable conditions, triggers both the flare and the Type III's at the same time. (auth)

9066 PREVALENCE OF SECOND HARMONIC RADIATION IN TYPE III BURSTS OBSERVED AT KILOMETRIC WAVELENGTHS. Haddock, F. T.; Alvarez, H. (Univ. of Michigan, Ann Arbor). Solar Phys.; 29: No. 1, 183-196(Mar 1973).

An analysis is presented of 64 Type III solar bursts that drifted from 3.5 MHz down to the range 350 to 50 kHz between March 1968 and February 1970. Bursts arrival times were predicted by a simple model and then compared with observations. The results show that, as the bursts drift, the fundamental often disappears below a certain frequency range while the second harmonic remains. Below about 1 MHz the second harmonic occurrence predominates. Recognizing this fact a mean velocity of $0.32c \pm 0.02c$ is deduced for the exciter particles, where the uncertainty is the standard error and c the velocity of light in vacuum; the electron density model used is comparable to a solar wind model. (auth)

9067 SOLAR-WIND DENSITY MODEL FROM km-WAVE TYPE III BURSTS. Alvarez, H.; Haddock, F. T. (Univ. of Michigan, Ann Arbor). Solar Phys.; 29: No. 1, 197-209(Mar 1973).

The analysis of Type III bursts observed from the OGO-5 satellite between 3.5 MHz and 50 kHz (λ6 km) gives an empirical expression for the frequency drift rate as a function of frequency that is valid from 75 kHz to 550 MHz. Using this expression and some simplifying assumptions an empirical formula is obtained for the electron density distribution of the solar wind to 1 AU which is consistent with published values of electron density and with observed Type III burst drift rates. (auth)

9068 CONTINUOUS EMISSION OF LOW-ENERGY COSMIC RAYS DURING SOLAR FLARES. Feit, J. (Queensborough Community Coll., Bayside, NY). Solar Phys.; 29: No. 1, 211-231(Mar 1973).

A new type of diffusion equation is presented in which the shape of the emission curve and the time during which the emission of energetic flare particles from the solar surface occurs can be prescribed. The diffusion equation utilizes a radially dependent diffusion coefficient in the form of $D = Mr^{\beta}$ and incorporates the convective and decelerative effects of the solar wind as well as external and internal boundary conditions to the interplanetary diffusion medium. The effect of the continuous emission of energetic solar particles on the intensity curves is shown. The logarithmic curve is utilized as a discriminant in testing for continuous emission and it predicts that in high-energy events, the particles are released in an impulsive burst within a few minutes after flare onset. The analysis of solar flare data is shown to be independent of either the convective or decelerative effects of the solar wind. The apparent deviation from the radial diffusion coefficient mode of propagation at very low energies is ascribed to continuous emission. The corresponding solar flare data at slightly higher energies or at different tracking satellite stations all indicate adherence to this mode for electrons as well as for protons. It is postulated that even in the very low-energy range, the radial mode prevails. On the basis of the accumulated data from twenty-six solar flares studied to date, it is asserted that the radial diffusion coefficient model is the basic mode by which solar flare particles propagate through interplanetary space. (auth)

9069 RESTRICTIONS ON RADIAL MAGNETIC FIELD AND FLOW SOLUTIONS FOR THE SOLAR WIND. Gussenhoven, M. S.; Carovillano, R. L. (Boston Coll., Chestnut Hill, MA). Solar Phys.; 29: No. 1, 233-241(Mar 1973).

In Parker's original model, the solar wind is represented as a spherically symmetric hydrodynamic flow. The velocity is radially directed and decoupled from the magnetic field. The simple extension of this model to include a dependence on the polar angle, θ, is shown to be invalid for radial flow and radial magnetic field. This work demonstrates how ad hoc symmetry conditions imposed to simplify a nonlinear problem can be incompatible with the basic hydromagnetic equations. (auth)

9070 ABSOLUTE CALIBRATION OF SOLAR RADIO FLUX DENSITY IN THE MICROWAVE REGION. Tanaka, H. (Nagoya Univ., Japan); Castelli, J. P.; Covington, A. E.; Krueger, A.; Landecker, T. L.; Tlamicha, A. Solar Phys.; 29: No. 1, 243-262 (Mar 1973).

The absolute calibration of solar radio flux density in the microwave region, which showed considerable discrepancies until 1966, has become completely uniform through international cooperative work. A complete history is described to avoid confusion, and correction factors are derived to convert the published values into absolute values for long series of routine observations. It is also shown that the most reliable calibration can be made by using a large pyramidal horn and by using sky and room temperature as calibration standards. (auth)

9071 GENERATION OF THE STELLAR MAGNETIC FIELD BY PARTLY IONIZED CONVECTIVE ENVELOPES. II. Drobyshevskii, E. M. (Ioffe Inst. of Physics and Tech., Leningrad). Astrophys (Engl. Transl.); 6: No. 3, 267-278(1970).

Translated from Astrofizika; 6: No. 3, 489-511(1970).

Generation of the magnetic field of a rotating star due to inertial emfs during the Coriolis acceleration of convective currents is discussed. The emf calculation includes not only the gas-dynamic interaction of convective elements, but also their interaction through the small-scale turbulent magnetic field frozen into the medium. Since the latter affects mainly the electrons, the emf considerably increases. Calculations are carried out for the Sun; these include the effect of the Coriolis forces on the gas parameters within the limits of the convective elements. The dependence of the generated magnetic field on the turbulent magnetic field $\overline{H}$ is investigated. Variation of $\overline{H}$ between 0 and 300 Oe, which corresponds to the solar photosphere, gives rise to a change in the field at the pole. (WDM)

Galaxies

Refer also to abstracts 8892, 8898, 8973, 9017, and 9121.

9072 (AD-751912) SEARCH FOR INTERSTELLAR ^{14}CO. Report for April-June 1972. Schwartz, P. R.; Wilson, W. J. (Aerospace Corp., El Segundo, Calif.). 15 Nov 1972. Contract F04701-72-C-0073. 12p. (SAMSO-TR-72-244). NTIS.

A search for interstellar ^{14}CO was made at 105 871.11 MHz in seven galactic ^{12}C sources with negative results. (auth) (NTIS)

9073 (AD-752042) APERTURE SYNTHESIS OBSERVATIONS OF MAFFEI 2 AT LAMBDA 21 cm. Wright, M. C. H.; Seielstad, G. A. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 20p. NTIS.

Maffei 2 is established as a rotating early-type spiral galaxy with a total mass exceeding 2.5×10^9 D(Mpc)$M_\odot$ and a fractional hydrogen content less than 0.015 D. The continuum emission has nuclear, disk, and halo components. (auth) (NTIS)

9074 RADIO SOURCE SAGITTARIUS A WEST: THERMAL OR NONTHERMAL. Jones, T. W. (Univ. of California, San Diego, La Jolla). Astrophys. Lett.; 14: No. 1, 47-50(1973).

Sgr A West, the radio source recently discovered in the galactic center, is discussed. It is shown that, although the spectrum is flat, a thermal interpretation is difficult to account for and that, therefore, the source may be nonthermal. Since the position of the source agrees closely with that of the 10-μm infrared source in the galactic nucleus, the two sources may be associated with nonthermal activity in the nucleus. (auth)

9075 EXPULSION OF DUST FROM GALAXIES. Chiao, R. Y. (Univ. of California, Berkeley); Wickramasinghe, N. C. Astrophys. Lett.; 14: No. 1, 19-23(1973).

The conditions for the expulsion by radiation pressure of dust particles from several types of galaxy are examined. Particles composed of graphite, iron, silicate, or ice, with sizes typical of interstellar grains, may be expelled from spiral and irregular galaxies, but not from elliptical galaxies. (auth)

9076 STELLAR CONTENT OF BRIGHT GALACTIC NUCLEI. Baldwin, J. R.; Danziger, I. J.; Frogel, J. A.; Persson, S. E. (Harvard Coll. Observatory, Cambridge, MA). Astrophys. Lett.; 14: No. 1, 1-6(1973).

The strengths of absorption bands due to H_2O and CO at 2.1 and 2.3 μm were measured for the nuclear regions of M31, M81, and NGC 5195. When compared with models of the stellar content of these galaxies, the observations seem to rule out the possibility of a dwarf-enriched main sequence. Optical observations of M81 and NGC 4594 indicate that the stellar population and metal abundance of the nuclear regions of these galaxies are similar to those of giant ellipticals. NGC 5195, on the other hand, seems to be a metal-poor system which is reddened by dust. (auth)

9077 PECULIAR MORPHOLOGY OF THE OUTER REGIONS OF NGC 1265 (3C 83.1 B) AND NGC 7720 (3C 465). Bertola, F. (Univ., Padua); Perola, G. C. Astrophys. Lett.; 14: No. 1, 7-10 (1973).

Deep photographs of NGC 1265 and 7720 reveal an asymmetry in the outer regions of these two galaxies, which appears to be correlated with the peculiar geometry of the associated radio sources, 3C 83.1 B and 3C 465. The possible nature of this asymmetry, as due to stars or to diffuse matter, and its origin are briefly discussed. (auth)

9078 ORIGIN OF ROTATION OF GALAXIES. Doroshkevich, A. G. (Inst. of Applied Mathematics, Moscow). Astrophys. Lett.; 14: No. 1, 11-13(1973).

It is proposed that galactic rotation originates as vorticity that is generated by shock waves arising in accordance with the nonlinear theory of gravitational instability. The proposed mechanism gives a specific angular momentum of approximately 10^{31} cm^2 sec^{-1}. (auth)

9079 PHOTOIONIZATION BY MASSIVE STARS IN PROTOGALAXIES. Tinsley, B. M. (Univ. of Texas, Dallas). Astrophys. Lett.; 14: No. 1, 15-17(1973).

It is postulated that the abundance of heavy elements found in the halo populations of galaxies is attributable to a short period of formation of massive stars during the collapse of the protogalaxies. The ultraviolet radiation from these stars fully ionizes the protogalaxy if its radius exceeds about 20 kpc. The combined effect of all protogalaxies is sufficient to ionize the intergalactic medium if their smoothed density exceeds about 0.06 that of intergalactic gas. (auth)

9080 49-CM LINEAR POLARIZATION DISTRIBUTION IN 3C 327 AND THE DENSITY OF INTERGALACTIC GAS. Kronberg, P. P.; Crelinsten, J. M. (Univ. of Toronto). Astrophys. Lett.; 14: No. 1, 25-30(1973).

Strip distributions at wavelengths of 49.1 and 21.1 cm of linearly polarized and total radiation are presented for the radio galaxy 3C 327. Distributed linear polarization exists at 49 cm, and the depolarization rates are used to infer an upper limit to the density of intergalactic gas (ρ_{ig}) which surrounds the larger radio component. It is unlikely that ρ_{ig} in the vicinity of 3C 327 exceeds 3×10^{-29} gm cm^{-3} in the portion of the cluster of galaxies to which 3C 327 appears to belong. This limit can be lowered by the factor by which the gas density in the radio clouds exceeds the density of the ambient intergalactic gas. (auth)

9081 TEMPERATURES OF SOME INTERSTELLAR CLOUDS. Milgrom, M.; Panagia, N.; Salpeter, E. E. (Cornell Univ., Ithaca, NY). Astrophys. Lett.; 14: No. 1, 73-75(1973).

It is suggested that dissociation of H_2 molecules by uv photons may be effective in heating the gas in clouds of high-enough density. The density dependence of this heating rate is similar to that of the heating by carbon ionization but the rate is about three times higher. The case of a cloud of constant density $n = 250$ cm^{-3} is examined. Sharp variations of the temperature may develop in the region where carbon goes from ionized to neutral. No such sharp variations appear where hydrogen goes from atomic to molecular. (auth)

9082 RE-CALCULATION OF EFFICIENCY FACTORS FOR RADIATION PRESSURE. Friedemann, C. (Univ., Jena, Ger.); Giese, R. H. Astrophys. Space Sci.; 15: No. 3, 401-403(Mar 1972).

Corrected values of the efficiency factor Q_{pr} of light pressure are presented for spherical particles of graphite and metallic materials. (auth)

9083 PROFILES OF THE DIFFUSE INTERSTELLAR LINES. Bromage, G. L. (Univ. of Edinburgh). Astrophys. Space Sci.; 15: No. 3, 426-461(Mar 1972).

The possibility that the diffuse interstellar lines and bands are but structure in the continuous extinction by dust grains is considered in detail. The lines are assumed to arise from impurities in the grains. Profiles of the strongest diffuse features are computed for a wide variety of host grain types and sizes, including size distributions of particles, and spheroidal and coated spherical grains. New observational profiles, of which '4430', '4765' and '4885' have been derived from automated spectrophotometry of electronographic spectra, are also presented; and comparison is made between theory and observation. The most useful tool of comparison is found to be the ratio of maximum apparent emission in the violet wing to maximum apparent absorption, q. This ratio increases with size of the host particle, and with both real and imaginary parts of its refractive index; but is independent of the observed variations in strength and width of a particular line. The ratio is larger for '4430' than for the other lines. Taking into account current opinion as to the composition of interstellar dust, the observations may be explained by the presence of impurities in either silicate grains with effective radii of about 120 nm, or possibly graphite grains about 50 nm in radius coated with a thin dielectric condensate. None of the observed profiles are at variance with the hypothesis that all the lines arise from the same impurities in the same type of grains. The concentration of such impurities needed to reproduce the observed line profiles and strengths is only about one in 10^4 atoms in the grain. (auth)

9084 OBSERVATIONS OF THE GENERAL BACKGROUND Hα EMISSION FROM THE GALACTIC PLANE. Meaburn, J. (Univ. of Manchester, Eng.). Astrophys. Space Sci.; 17: No. 2, 499-502(Aug 1972).

Photographic surveys, through narrow band Hα filters have indicated the existence of huge but faint ionized hydrogen regions between the principal H II regions, planetary nebulae, and supernova remnants in the Galaxy. A mosaic of photographs, very sensitive to variations in brightness of the diffuse Hα emission 10° fields is presented that reveals particularly well the structure of the many large areas of this background emission from the less confused region of the anticenter of the galactic plane. (WDM)

9085 RELATIVE MERITS OF GALACTIC DENSITY FUNCTIONS: AN ORBIT COMPUTATIONAL VIEWPOINT. Innanen, K. A.; Ryman, A. G. (York Univ., Downsview, Canada). Astrophys. Space Sci.; 17: No. 2, 447-452(Aug 1972).

Certain analytical functions used in galactic mass models are reviewed from a somewhat biased orbit-computational viewpoint. On this basis, it is argued that at the present time, an optimal galactic mass model should be a superposition of spheroids with two kinds of density laws; the Schmidt (1956) type, and a new type given herein. (auth)

9086 DIFFUSE GALACTIC FUV RADIATION AND INTERSTELLAR DUST GRAINS. Yoshioka, S. (Kyoto Sangyo Univ.). Astrophys. Space Sci.; 16: No. 3, 421-431(Jun 1973).

A re-analysis of the diffuse far uv radiation ($\lambda\lambda$ 1350 to 1480Å) observed in the region $l^{II} \approx 180°$ and $0° \lesssim b^{II} \lesssim 40°$ is presented, as a revised version of a paper by Hayakawa et al. (1969). In comparison with the previous one, the value of the half optical depth of the Galaxy τ in the wavelength region is reduced, and the values

of the albedo coefficient γ and the forward phase function g are not well determined. If, however, the results are combined with the theoretical model of interstellar grains by Gilra, the value of τ is given by $0.13(5) \lesssim \tau \lesssim 0.18(5)$. (auth)

9087 CHERENKOV AND TRANSIENT RADIATION OF UNIFORMLY MOVING CHARGE IN RANDOM INHOMOGENEOUS MEDIUM. Tamoykin, V. V. (Radiophysical Research Inst., Gorky, USSR). Astrophys. Space Sci.; 16: No. 1, 120-129(Apr 1972).

Radiation of a uniformly moving charged particle in a medium with weak random inhomogeneities of dielectric permittivity is considered. The expression for the charge energy losses is obtained by the method of radiation reaction using the tensor of the effective permittivity. The limiting cases of small- and large-scale inhomogeneities are studied. Peculiarities of energy losses near the threshold of Cherenkov radiation are clarified. (auth)

9088 GRAVITATIONAL FIELD OF FLAT GALAXIES. Clutton-Brock, M. (Univ. of Washington, Seattle). Astrophys. Space Sci.; 16: No. 1, 101-119(Apr 1972).

A set of bi-orthogonal pairs of functions is derived which is especially suited for the calculation of the gravitational field of flat galaxies. The functions are Hankel transforms of associated Laguerre functions, or "Hankel–Laguerre functions." They can be calculated by means of recurrence relations, which are derived from a generating function. Numerical computations are most efficiently performed using a related set of Chebyshev type functions, which have more economic recurrence relations. The necessary algorithms for efficient calculation of the field are derived using the properties of Hankel–Laguerre functions. This field calculation can be used for a relatively cheap and simple computer simulation of galaxies. (auth)

9089 ABSORPTION FEATURE AT 2200 Å IN THE INTERSTELLAR REDDENING CURVE. Swamy, K. S. K. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 16: No. 1, 75-80(Apr 1972).

The profile of the absorption feature at 2200 Å was calculated for model grains of graphite, graphite core-dirty ice mantle, and silicate. They are compared with the observed profile obtained by Bless and Savage from a number of early type stars. It is also shown that it is unlikely that the radiation damage of silicates in interstellar space can also contribute to the absorption feature at 2200 Å. The objections that have been raised on the silicate model are discussed. (auth)

9090 HIDDEN MASS IN THE SOLAR NEIGHBORHOOD. Kumar, S. S. (Univ. of Virginia, Charlottesville). Astrophys. Space Sci.; 17: No. 1, 219-222(Jul 1972).

It is suggested that the minimum mass of a star at the time of its formation is approximately 0.01 $M_\odot$. Making use of this fact and the stellar mass function $F(M) \propto M^{-\alpha}$, it is found that the hidden mass (or the missing mass) in the solar neighborhood may be explained by the presence of a large number of invisible stars of very low mass ($0.01\ M_\odot \lesssim M < 0.07\ M_\odot$). (auth)

9091 INFLUENCE OF THE SURFACE ROUGHNESS OF GRAINS UPON THE LAW OF INTERSTELLAR EXTINCTION. Svatos, J. (Charles Univ., Prague). Astrophys. Space Sci.; 17: No. 1, 238-240(Jul 1972).

Recently Shah and Vardya (1971) have presented a simple model of surface roughness on spherical grains. It is shown that for estimating the scattering properties of rough grains in the far infrared it is more convenient to investigate the intensity of the scattered light instead of the extinction cross-sections of the grains. (WDM)

9092 STABILITY OF STRONGLY NONHOMOGENEOUS SELF-GRAVITATING EQUILIBRIA. Cuperman, S.; Harten, A. (Tel Aviv Univ., Ramat Aviv, Israel). Astrophys. Space Sci.; 18: No. 1, 207-222(Sep 1972).

The stability analysis of several strongly nonhomogeneous, self-gravitating, one-dimensional unstable equilibrium systems is carried out with the help of numerical techniques. The evolution of the "perturbed" unstable equilibria is studied by following the motion of the boundary curves of "water bag" configurations defining the systems. It is found that initial perturbations drive the unstable equilibrium states out of equilibrium at rates depending on the typical scale length of the perturbations λ; the instability rates increase with λ. (auth)

9093 INFRARED VARIABILITY OF A DUST MODEL FOR SEYFERT GALAXIES. Kaneko, N.; Toyama, K.; Nishimura, N. (Hokkaido Univ., Sapporo). Astrophys. Space Sci.; 18: No. 1, 121-127(Sep 1972).

Assuming a dust model of Rees et al. (1969), the time dependence of the infrared emission from grains which absorb variable ultraviolet radiation was studied. A time scale for the variability is shown to be fairly small compared with the light travel-time across the infrared emitting region, of which size depends on the wavelength strongly. Comparison of calculated infrared light curves with observations of NGC 4151 leads to the conclusion that the variability at 2.2 μ is consistent with interpretation by the infrared emission on the basis of thermal process. (auth)

9094 RADIATIVE MODES OF A WEAKLY IONIZED, COLLISION DOMINATED; TURBULENT PLASMA. Lerche, I. (Univ. of Chicago). Astrophys. Space Sci.; 18: No. 1, 94-103(Sep 1972).

The roots of the dispersion relation describing normal mode propagation in a weakly ionized, collision dominated turbulent plasma with an isotropically distributed turbulent magnetic field are considered. It is demonstrated that, depending on the level of the turbulent field relative to the collision frequency, there may, or may not, be propagating, but decaying, modes present in the system. The structure and properties of the modes depend on both the precise level of the turbulent magnetic field and its spatial and temporal correlation. For simple correlation functions the decay rate of the radiative modes is estimated. Using galactic parameters as an illustration it is shown that only the long-wavelength (low-frequency) modes last for a significant length of time ($\gtrsim$ a collision time). It is demonstrated that the response of turbulent plasma systems is more complicated than simple order of magnitude calculations indicate; and a method is illustrated which may, perhaps, be gainfully employed in more complex turbulent astrophysical plasma situations than considered here. (auth)

9095 CHEMICAL COMPOSITION OF THE INTERSTELLAR GAS: X-RAY DETERMINATIONS. Brown, R. L. (National Radio Astronomy Observatory, Green Bank, WV). Astrophys. Space Sci.; 18: No. 2, 329-333(Oct 1972).

Noting that observations of x-ray attenuation at the K-shell ionization edge for many elements provide, prospectively, the least ambiguous means for establishing the chemical composition of the interstellar gas, the expected spectral discontinuities for all atoms from carbon to sodium were evaluated and the results are tabulated. It is shown that with x-ray detectors of reasonable energy resolution and sensitivity the K-shell edges of C, N, O, Ne, Si, S, Ar, and Mg are potentially observable if the "cosmic" abundances are representative of the general interstellar environment. (auth)

9096 HOW ARE INTERGALACTIC FILAMENTS MADE. Clutton-Brock, M. (Univ. of Washington, Seattle). Astrophys. Space Sci.; 17: No. 2, 292-324(Aug 1972).

Computer simulations are performed which suggest that narrow intergalactic filaments can be produced by tidal forces. A fixed potential perturber passes a self-gravitating disk of stars in a nearly parabolic orbit. Due to their large velocity dispersion, the stars which are pulled out by the tide form only an amorphous cloud. The gas clouds are simulated by a disk of points of zero mass, zero velocity dispersion superimposed on the stellar disk. The "gas clouds" form remarkably long, narrow filaments; but not so narrow as the narrowest filaments observed. (auth)

9097 ORIENTATION OF INTERSTELLAR AND INTERPLANETARY GRAINS. Dolginov, A. Z. (Ioffe Inst. of Physics and Tech., Leningrad). Astrophys. Space Sci.; 18: No. 2, 337-349 (Oct 1972).

The explicit expressions for the orientation distribution function of interstellar and interplanetary dust grains in the anisotropic corpuscular or radiation fluxes, with consideration for the magnetic field influence, are obtained. An orientation is shown to be possible in a medium having an anisotropic temperature, which is usually the case for a nonequilibrium plasma in a magnetic field. It is noted that the small inhomogeneous dust grains should possess a specific rotation of polarization. The orientation of these dust grains is considered. The time required for the orientation is estimated. A possibility of explaining the interstellar polarization and polarization of the cometary radiation is discussed. (auth)

9098 INFALL OF GAS FROM INTERGALACTIC SPACE AND SOFT X-RAY BACKGROUND. Tosa, M. (Tohoku Univ., Sendai); Kato, T. Astrophys. Space Sci.; 18: No. 2, 504-513 (Oct 1972).

As the origin of the soft x-ray background, emission of soft x-rays from shocks occurred in the accretion of intergalactic gas onto the Galaxy is studied. Infall of discrete gas clouds cannot explain the diffuse component of soft x rays. If intergalactic gas rich in heavy elements as the cosmic abundance continuously flows into the Galaxy and forms a standing shock surrounding the Galaxy, the line emissions by heavy elements from the shocked gas explain the soft x-ray background. Formation of the high-velocity cloud by

thermal instability in the shocked gas is also discussed briefly. (auth)

9099 STATISTICAL SIGNIFICANCE OF SOME OPTICAL EVIDENCE FOR THE BENDING OF THE GALACTIC PLANE. Sher, D. Astrophys. Space Sci.; 18: No. 2, 468-471(Oct 1972).

It is argued on the basis of an analysis of variance test that the distribution of Wolf–Rayet stars in the Galaxy departs systematically from the plane in the same sense as the neutral hydrogen. (auth)

9100 PREDICTIONS OF EXCEPTIONALLY STRONG 4430 IN THE BACKSCATTERED LIGHT FROM REFLECTION NEBULAE. Bromage, G. E. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 18: No. 2, 449-461(Oct 1972).

The strength of the "4430" interstellar spectrum feature in the backscattered light from certain reflection nebulae is shown to be a sensitive indicator of the feature's origin. Backscattering "4430" profiles were computed for several models of silicate, graphite, dirty-ice-coated graphite, and silicon carbide grains with impurities. The effect on these profiles of both nonsphericity of the grains and finite optical thickness of the reflection nebula were considered. For silicate grains, the "4430" central depth is predicted to be up to ten times its value in the corresponding extinction profile, whereas for graphite only a rather weak feature is expected. Some comments are made concerning the future comparison of observations with these theoretical results. (auth)

9101 SOME LIMITS ON COSMIC-RAY HEATING OF H I CLOUDS BY MAGNETIC STARS. Guthrie, B. N. G. (Royal Observatory, Edinburgh). Astrophys. Space Sci.; 18: No. 2, 403-407(Oct 1972).

Estimates are made of the low-energy, cosmic-ray power generated by the rotational braking of magnetic Ap stars through interaction with the interstellar medium. The resulting cosmic-ray power density ($\lesssim 1.4 \times 10^{-29}$ J s^{-1} m^{-3}) in the galactic plane is at least three orders too small to maintain the observed kinetic temperatures (~100K) of H I clouds. About 0.4% of H I clouds contain an Ap star; in such cases ~10^{26} J S^{-1} may be generated by the star during the early part of its main sequence lifetime, but this makes only a small contribution to the heating of the cloud. (auth)

9102 ESTIMATE OF THE ENERGY SPECTRUM OF GAMMA RAYS FROM THE CENTRAL REGION OF THE GALAXY AND SOME IMPLICATIONS. Anand, K. C.; Stephens, S. A. (Tata Inst. of Fundamental Research, Bombay). Astrophys. Space Sci.; 18: No. 2, 387-402(Oct 1972).

High-resolution surveys of the galactic center suggest the existence of an extended non-thermal source (bulge) with an intensity much larger than the total background radiation in that direction. The physical conditions existing in this restricted region of space are evaluated from an analysis of the radio spectrum and it is shown that if the distribution of matter, magnetic field B(r), and cosmic-ray density k (r) in the plane of the Galaxy is of gaussian type then at the center $B_\perp(0)$ = 25 to 30 μG and K(0) = 25 to 35 times that in the near interstellar space. It is also found that most of the absorption in the Sagittarius A spectrum at low frequencies takes place in the bulge and one requires a small additional absorption to take place in the line of sight corresponding to $\langle n_e^2 \rangle \lesssim 10$ cm^{-6} pc at a temperature typically of clouds $\lesssim$100 K. The gamma-ray spectra from the bulge arising from interactions of cosmic rays with matter and radiation are then calculated in detail. A comparison made with the estimated background gamma-ray spectra from the disk reveals that a detector with angular resolution $\leq 6°$ having a threshold of a few times 10^{-6} photons cm^{-2} s^{-1} can detect this source; this bulge is not found to be a good x-ray source for detection. From a comparison of these calculations with the observed flux above 100 MeV, the following inferences are deduced: (i) the lower limit to the magnetic field strength at the center is 12 μG, (ii) the observed gamma-ray flux towards the anti-center can be well explained as due to interactions of cosmic rays with matter alone and a similar explanation towards the center reveals that cloud complexes could be more in the inner parts of the Galaxy than in the outer parts, and (iii) the observed flux values are found to be inconsistent with the existence of submillimeter radiation in the galactic scale. (auth)

9103 SPIRAL STRUCTURE OF OUR GALAXY. Marochnik, L. S.; Mishurov, Yu. N.; Suchkov, A. A. (Rostov State Univ., Rostov-on-Don, USSR). Astrophys. Space Sci.; 19: No. 2, 285–292(Dec 1972).

It is shown that properties of the spiral wave in the Galaxy are determined by the mass distribution of its flat subsystem rather than by the full mass distribution. Then it turns out that better agreement with the observed spiral pattern furnishes the "long" waves in contrast to the "short" waves in the Lin et al. (1969) theory. With the surface density $\sigma_1 = 40 M_\odot/ps^2$ which is taken in the first approximation as independent on the galacto-centric distance, and the pattern velocity Ω_p = 23 km/s kps, the evaluated spiral pattern fits surprisingly well with the Weaver (1970) map of the HI-distribution in the Galaxy, and is in good agreement with the Kerr (1969) map. The inner Lindblad resonance occurs at 2 kps from the Galaxy center, where Weaver has placed the ring condensation of the gas, and the outer resonance lies close by 14 kps. At the outer resonance the nonlinear phenomena are expected, which lead to chaotization of the regular structure. This seems to be consistent with the Weaver (1970) and Kerr (1969) maps. The hypothesis is suggested which associates the generating mechanism of spiral waves with the rotating bar of old stars in the center of the Galaxy. Depending on the velocity of the bar rotation and the bar length, different combinations of the normal wave pattern and bar-like structure may occur, which possibly explains the great variety of transition forms between normal and barred spirals. In the proposed theory the packet of spiral waves moves from the inner Lindblad resonance outwards and could be permanently maintained by the "generator" in the center of the Galaxy. Therefore, the difficulty associated with the rapid obliteration of the packet (Toomre, 1969) does not arise. (auth)

9104 REMARKS ON THE SOFT X-RAY EMISSION FROM THE GALACTIC RADIO SPURS. Raychaudhuri, P. (Univ. of Oulu, Finland). Astrophys. Space Sci.; 19: No. 1, 145–149(Nov 1972).

It is pointed out that all the old supernova remnants are not in general sources of soft x-ray emission. Again it is pointed out that the galactic radio spur (Cetus arc) may be an old supernova remnant but it has already ceased to be a source of x-ray emission. Finally x-ray flux from Vela is estimated from the cooling rate of a neutron star by neutrino emission. The results agree approximately with the observed x-ray flux from Vela X. (auth)

9105 SMALL PERTURBATIONS IN FLAT GALAXIES. I. Equilibrium Models and Adiabatic Perturbations. Clutton–Brock, M. (Univ. of Sussex, Brighton, Eng.). Astrophys. Space Sci.; 19: No. 1, 225-247(Nov 1972).

The aim of this series of papers is to develop straightforward methods of computing the response of flat galaxies to small perturbations. The general approach is to study the dynamics of each individual orbit. The orbits are described by their apocentric and pericentric radii, r_a and r_p, and the distribution function of an equilibrium model is a function of r_a and r_p. The mass density and potential corresponding to a distribution function are found by means of an expansion in Hankel–Laguerre functions; the coefficients of the expansion being found by taking moments of the mass density of the individual orbits. This leads to a simple method of constructing equilibrium models. The response to a small perturbation is found by seeking the response of each orbit. When the perturbations are axisymmetric and slowly varying, the response can be easily found using adiabatic invariants. The potential is expanded in a series of Hankel–Laguerre functions, and the response operator becomes a discrete matrix. The condition that the model is stable against adiabatic radial perturbations is that the largest eigenvalue of the response matrix should be less than one. An analytic approximation to the response matrix is derived, and applied to estimate the eccentricity needed for stability against local perturbations. (auth)

9106 GRAVOTHERMAL CATASTROPHE IN ROTATING GALAXIES. Clutton–Brock, M. (Univ. of Sussex, Eng.). Astrophys. Space Sci.; 19: No. 1, 201–206(Nov 1972).

Violent relaxation in a rotating galaxy can lead to a core–halo system. In order to understand this, a very crude model is studied in which all details are ignored, and only the dimensions of physical quantities are retained. The behavior depends on the ratio η of the potential in the core to the potential in the halo. When $\eta > 5/2$, the core contracts; when $\eta > 5$, the contraction is a runaway process, or "gravothermal catastrophe". (auth)

9107 APPLICATION OF CRAMER'S THEOREM TO AXISYMMETRIC, INCOMPRESSIBLE TURBULENCE. Lerche, I. (Univ. of Chicago). Astrophys. Space Sci.; 19: No. 1, 189–193(Nov 1972).

In the theory of homogeneous, stationary, axisymmetric, incompressible velocity turbulence there arise four scalar functions. The incompressibility condition provides two relations between these four functions. It is demonstrated that application of Cramer's theorem imposes two additional constraints on the four functions. These constraints do not uniquely define the allowed functional form but they do provide very powerful criteria for limiting the class of functions which are permitted. In view of the growing use of velocity turbulence in kinematic dynamo theory and its importance in astrophysical situations (e.g., Earth, Sun, Galaxy) to maintain or regenerate a large scale magnetic field, it is believed that the present constraints are of more than academic interest. In

particular, application of the constraints to a form of velocity turbulence used by Steenbeck, Krause, and Rädler when computing kinematic dynamo action, shows that their assumed turbulence is not physically realizable in nature. (auth)

9108 DISTANCE-REDSHIFT RELATIONS FOR UNIVERSES WITH SOME INTERGALACTIC MEDIUM. Dyer, C. C.; Roeder, R. C. (David Dunlap Observatory and Scarborough College, University of Toronto). Astrophys. J. Lett. 180: No. 1, L31-L34 (15 Feb 1973).

The distance-redshift relations for universes with a constant fraction of the mean density in the form of intergalactic matter are shown to be solutions of a hypergeometric equation. Solutions can be given in closed form for $\alpha=0$, 2/3, and 1. (auth)

9109 EXTRAGALACTIC X-RAY SOURCES AND THE X-RAY BACKGROUND. Fabian, A. C. (Univ. Coll., London). Nature (London) Phys. Sci.; 242: No. 122, 134(30 Apr 1973).

It is stated that although the existence of the cosmic x-ray background has been known for some years its origin has not been identified. Many theories have been proposed, and much use has been made of the so-called "spectral break" at about 40 keV, but recently doubt has been cast on the sharpness, and indeed existence, of the break. Publication of the Uhuru catalogue has provided a significant increase in data on extragalactic x-ray sources, and it was thought desirable to study the relevance of these to the x-ray background. Many sources, including those still unidentified and others as yet undetached, must all contribute to the x-ray background. The summed spectra of the objects so far identified do not lead to a spectrum close to that of the x-ray background in the 2 to 6 keV range, and it may be that another kind of object is involved. Seyfert nuclei may be a possibility. (UK)

9110 TIME VARIATION OF METAL ABUNDANCE IN GALAXIES. Super-Metal-Rich Stage. Ikeuchi, S. (Kyoto Univ.); Sato, T.; Takeda, H.; Sato, H. Progr. Theor. Phys. (Kyoto); 48: No. 6, 1885-1898(Dec 1972).

Time variation of metal abundance Z in the interstellar gas was studied and it was found that the abundance Z does not necessarily increase monotonously with time. Super-metal-rich stars are explained as the stars formed during the peak stage of Z, which appeared at $(1 \pm 0.5) \times 10^9$ years after the start of star formation in galaxies. After the peak stage, the metal abundance approaches some constant value, which is determined by the final stellar structure and the mass spectrum of stars. (auth)

9111 CHAIN OF GALAXIES IN CENTAURUS. Sersic, J. L.; Agueero, E. L. (Observatorio Astronomico, Buenos Aires). Astrophys. Space Sci.; 19: No. 2, 387-394(Dec 1972).

Further photometric and spectroscopic observations of a chain of galaxies in Centaurus are presented and discussed. (auth)

9112 NATURE OF NGC 5253. Sersic, J. L. (Observatorio Astronomico, Buenos Aires); Pastoriza, M. Astrophys. Space Sci.; 19: No. 2, 469-494(Dec 1972).

It is proposed that NGC 5253 has been the place of a violent event like M82. The presence of a long jet and the characteristics of its nuclear complex points to this interpretation. (auth)

9113 SEARCH FOR INFRARED ANOMALIES ASSOCIATED WITH GRAVITATIONAL EVENTS AT THE GALACTIC CENTRE. Slusher, R. E.; Tyson, J. A. (Bell Telephone Labs., Inc., Murray Hill, NJ). Nature (London); 243: No. 5401, 25(4 May 1973).

Bursts of gravitational radiation apparently arriving from the direction of the galactic center have been reported; and the resulting mass loss implied by the estimated energy flux of about 100 W/cm^2 at the Earth has given rise to much theoretical discussion with regard to possible source models. The results of a search for accompanying bursts of infrared radiation from the galactic center region are here reported. Observations were made from the Cerro Tololo Inter-American Observatory, Chile, over the period July 24 to August 8, 1972, employing a liquid N_2 cooled PbS detector. Coincident fluctuations in infrared levels were not found, and if the reported high flux gravitational events are confirmed there appear to be several possible explanations for this. If there is a net polarization of the gravitational radiation the location of its source is not near the galactic center region. Furthermore, dust in the dense region within 1 pc of the galactic center may absorb most electromagnetic radiation, re-emitting it over comparatively long periods of time. Lastly, there may be very little electromagnetic radiation accompanying the gravitational events. Consideration is narrowed to a small region near the galactic nucleus, since the high mass density there makes gravitational radiation more plausible. (UK)

9114 LIMIT TO PULSES OF RADIOFREQUENCY EMISSION FROM THE GALACTIC CENTRE. O'Mongain, E. (Smithsonian Astrophysical Observatory, Mount Hopkins, AZ). Nature (London) Phys. Sci.; 242: No. 122, 136-137(30 Apr 1973).

The nucleus of the Galaxy, at the position of the Sgr A radio source, has been searched for pulses of radio emission in the frequency range 1650 to 1720 MHz. Pulses of short duration might be emitted in association with pulses of gravitational radiation or with other shock waves, collapse or flare phenomena. A previous attempt to detect radio pulses suggested a possible source of pulses near the galactic centre. The study here described was designed to detect the relative dispersion delay that the interstellar medium would impose at different frequencies on any signal from the galactic center. In order to accomplish such detection continuous simultaneous observations at two frequencies were made; the demand for delayed pulses at the lower frequency with respect to the higher frequency provides a discrimination against man-made or terrestrial pulses, which lack dispersion effects. The observations were made with the 25.6 m radiotelescope of the Smithsonian Astrophysical Observatory at operating frequencies of 1713 and 1665 MHz, between July 30 and August 8, 1972, with the telescope centered on Sgr A. Dispersion measures of 5×10^3 to 10^6 electrons/cm^3 pc would have modified any source pulse of duration 0.1 to 20s, giving a detectable difference in arrival time for the two frequencies, and for a distance of 10 kpc the dispersion measure should be longer than 3×10^3 electrons/cm^3 pc. During 28 hr. of interference-free operation no pulses of possible astrophysical origin greater than 5K over the mean, or 63 fa, were observed during the duration limit of 0.1 to 20s. In 28 hr. there should be at least one gravitational pulse in the field of view, if such pulses are generated at the galactic center. The limits to pulses, other than gravitational, place interesting constraints on the rate of catastrophic events or emission from them. Radiofrequency pulse limits from the galactic center and from Andromeda are shown tabulated. (UK)

9115 SUPERNOVAE AS INDICATORS OF DISTANCES. Kwast, T. (Univ., Warsaw). Astrophysics (Engl. Transl.); 6: No. 3, 218-220(1970).

Translated from Astrofizika; 6: No. 3, 405-409(1970).

The maximum distance of a supernova from the center of its parent galaxy is estimated on the basis of the "Preliminary Catalogue of Supernovae" by Karpowicz and Rudnicki. This maximum distance is equal to about 13 kpc. This value permits the estimation of the distances to clusters of galaxies if one evaluates the maximum angular distance of the supernova from the center of the galaxy for some cluster. The accuracy seems to be quite good when the number of supernova observed in the cluster is equal to at least five. (auth)

9116 SPECTRA OF MARKARYAN GALAXIES. II. Arakelyan, M. A.; Dibai, E. A.; Esipov, V. F.; Markaryan, B. E. (Shternberg Astronomical Inst., Erevan). Astrophysics (Engl. Transl.); 6: No. 3, 189-194(1970).

Translated from Astrofizika; 6: No. 3, 358-366(1970).

The results of spectral observations of 60 new objects from the listing of galaxies with ultraviolet continuum are reported. Emission lines in the spectra of 36 objects are recorded, including two or three previously classified as having no emission lines. Objects Nos. 78, 110, 142, and 198 have spectra with broad emission lines characteristic of the nuclei of Seyfert galaxies. New observations of objects Nos. 99 and 105, earlier suspected as being of the Seyfert type, have confirmed the presence of broad lines in the spectrum of only the latter. (auth)

9117 MODELS OF CLUSTERS OF POINT MASSES WITH QUADRATIC GRAVITATIONAL POTENTIAL. Bisnovatyi-Kogan, G. S.; Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 6: No. 3, 207-213(1970).

Translated from Astrofizika; 6: No. 3, 387-396(1970).

The motion of particles in their common gravitational field is considered in the case of oblate, disk-shaped, and other nonspherically-symmetric configurations. Solutions are found of the kinetic equation with a self-consistent field with a quadratic potential. Exact solutions are obtained for a circular disk with anisotropic velocity distribution, a disk of elliptic cross section, an ellipsoid of revolution with arbitrary angular momentum (including zero), and a cylinder of elliptic cross section. (auth)

9118 PHOTOMETRY OF SUPERASSOCIATIONS IN TWELVE DISTANT GALAXIES. Shakhbazyan, R. K. (Byurakan Astrophysical Lab., USSR). Astrophysics (Engl. Transl.); 6: No. 3, 195-202(1970).

Translated from Astrofizika; 6: No. 3, 367-377(1970).

The results are reported of a photometric and colorimetric study of 28 superassociations in 12 galaxies of late morphologic type. The observations were carried out with the 40" and 21-21" Schmidt telescopes at the Byurakan Observatory. The superasso-

ciations have absolute photographic magnitudes between −14.0 and −17.2, and their B−V and U−B colors lie between −0.3m and +0.3 m and between −1.0 m and −0.5m, respectively. Photographs of the galaxies, indicating the position of the superassociations in them, are reproduced. (auth)

Cosmology

Refer also to abstract 9030.

9119 ORIGIN OF THE MAGNETIC FIELD. Bergstroem, A. (Research Inst. of National Defence, Stockholm). Nuovo Cim.; 14B: No. 2, 235-242(11 Apr 1973).

The nature of the magnetic field is discussed. In the customary descriptions, the existence of the magnetic field is either axiomatically introduced through the Maxwell equations, or enters in the form of an additional term to the electric force in a moving system resulting from the Lorentz transformation of the force vector. The present paper studies the latter approach in a new way by performing it in two steps, and describes the magnetic force as a Coriolis force resulting from the Thomas rotation caused by the electric force. The Larmor theorem, the vector-potential concept, and the quantum nature of the electromagnetic field are also discussed in terms of this novel approach. (auth)

9120 SCALAR−TENSOR THEORIES AND CONFORMAL INVARIANCE. O'Hanlon, J.; Tupper, B. O. J. (Univ. of New Brunswick, Fredericton). Nuovo Cim.; 14B: No. 2, 190-202 (11 Apr 1973).

In general scalar−tensor theories of gravitation involve at least two arbitrary functions of the scalar field. Various methods of eliminating this arbitrariness are reviewed. It is shown that the requirement of conformal invariance leads to a particular Jordan theory together with a quartic self-interaction term. Some examples of conformal invariant systems are discussed. The requirement that, in vacuum, the theory should lead to a scalar wave equation reduces the general action principle to that of the Jordan theory. It is also shown that, in vacuum, all the Jordan theories are equivalent to the Brans−Dicke theory. (auth)

9121 INTERGALACTIC IONIZED HYDROGEN IN NEARBY GROUPS OF GALAXIES. Chamaraux, P. (Observatoire, Meudon, France); Montmerle, T.; Tadokoro, M. Astrophys. Space Sci.; 15: No. 3, 383-394(Mar 1972).

Stability of the nearest 14 groups of galaxies is investigated by means of Jacobi's criterion. In this way these groups are found strongly unstable, except perhaps two. The result is unaltered when the validity of the assumptions needed for the computations are considered and when the inaccuracy of the data are taken into account. This apparent instability is tentatively explained by presence of intergalactic ionized hydrogen in each group. Physical parameters of the gas are derived by means of the general modified form of the virial theorem and through the assumption of the equipartition among several modes of energy. The main results are the following: the ratios of the gas mass to the sum of the masses of the member galaxies are of the order of 10, densities q_g of the gas are about 10^{-29} to 10^{-28} g cm^{-3}, and temperatures are of the order of 10^5K. Values of each physical parameter of the gas show little change from one group to the next. As significant correlation: $q_G \propto q_g^{0.9}$ is obtained between q_g and the density q_G of the visible matter for the various groups; it may be compatible with the assumption that the intergalactic gas is a remnant of the condensation of the galaxies. Then it is shown that, at present, the observations are not opposed to the treatment. Finally, it is noticed that detection of intergalactic gas in the groups investigated will be very difficult, except if this gas is strongly cloudy. (auth)

9122 BRANS−DICKE THEORY AND ANISOTROPIC COSMOLOGIES. Matzner, R. A. (Univ. of Texas, Austin); Ryan, M. P.; Toton, E. T. Nuovo Cim.; 14B: No. 2, 161-172(11 Apr 1973).

The Hamiltonian method developed to study homogeneous, anisotropic cosmological models can be extended to the equivalent models in the Brans−Dicke theory. Universes of Bianchi Types I and IX are studied and diagrammatic solutions are obtained in both cases. (auth)

9123 GALILEAN ELECTROMAGNETISM. Le Bellac, M. (Faculte des Sciences, Nice); Levy−Leblond, J. M. Nuovo Cim.; 14B: No. 2, 217-234(11 Apr 1973).

Consistent nonrelativistic electromagnetic theories are investigated by stressing the requirements of Galilean relativity. It is shown that Maxwell's equations admit two possible nonrelativistic limits, accounting respectively for electric and magnetic effects. A Galilean theory is then built which combines these two theories and can embody a large class of experimental facts. As a result, several so-called "relativistic" effects are shown to necessitate a re-appraisal, or at least, a more careful discussion. It is finally shown precisely how the old-fashioned formulation of the electromagnetic theory in terms of field strengths and field excitations clashes with Galilean relativity in its constitutive equations only, leading to the idea of a privileged frame of reference (the ether) or to Einsteinian relativity. (auth)

9124 SPHERICALLY SYMMETRIC METRICS AND FIELD EQUATIONS IN FOUR DIMENSIONAL SPACE. Lovelock, D. (Univ. of Waterloo, Ont.). Nuovo Cim.; 14B: No. 2, 260-266 (11 Apr 1973).

Corresponding to metrics of the form (A) $ds^2 = e^{\lambda}dr^2 + r^2(d\theta^2 + \sin^2\theta\, d\varphi^2) - e^{\mu}dt^2$, where $\lambda = \lambda(r)$, $\mu = \mu(r)$, there are only two independent Euler−Lagrange equations associated with the Lagrange density (B) $L = \sqrt{g}f(R_i^i;\ R_j^iR_i^j;\ R_j^iR_h^iR_i^h;\ R_j^iR_h^jR_k^hR_i^k)$, where R_j^i is the Ricci tensor. Furthermore, these two independent equations are equivalent to the two equations obtained by substituting (A) in (B) and then regarding λ and μ as the quantities to be varied from the point of view of the calculus of variations. (auth)

9125 DISTRIBUTION OF THE DIFFUSE COMPONENT OF COSMIC SOFT X-RAYS. Kato, T. (Nagoya Univ., Japan). Astrophys. Space Sci.; 16: No. 3, 478-498(Jun 1972).

The celestial distribution of the intensity of diffuse soft x rays is mapped by reference to a critical review of observations available. The soft x rays of extragalactic origin are subtracted, taking the interstellar absorption into account. The distribution of the galactic component thus obtained shows irregularities, but the general behavior can be accounted for in terms of a cylindrical distribution of the x-ray emissivity with the scale height of 100 ~ 300 pc in the direction perpendicular to the galactic plane. Correlations with various celestial objects, such as supernova remnants, radio spurs, flaring stars, and so forth, are discussed. (auth)

9126 GRAVITATION AND ELECTROMAGNETISM. Leiby, C. C. Jr. (Leghorn Labs., Bedford, MA). Astrophys. Space Sci.; 17: No. 2, 368-377(Aug 1972).

The Maxwell equations for gravitational fields previously assumed by Sciama are derived from elementary considerations. The Lagrangian for a gravitating mass in a noninertial coordinate system yields equations of motion leading to force definitions for a gravitational field intensity and a gravitational induction field. The noninertial velocity of the coordinate system plays the role of a vector potential contributing to the generalized momenta of bodies moving in the system. A Lagrangian density constructed from the force-defined fields then lead to the source definitions of gravitational fields. It is found that positive field energy densities require repulsive gravitational forces, whereas attractive forces imply the violation of the conservation of energy. This paradox is resolved by representing gravitational quantities as pure-imaginary entities. Thus characterized, the equations which define gravitational fields become identical to Maxwell's equations but are pure-imaginary. This suggests a combined representation for gravitational and electromagnetic fields which, in covariant form, indicates both the well known equivalence of mass and energy and a possible equivalence of charge and energy. From orthogonality considerations, it is conjectured that this latter energy is gravitational, and that, whereas gravitational fields interact with electromagnetic energy, electromagnetic fields interact with gravitational energy. (auth)

9127 COSMOLOGICAL VACUUM SOLUTIONS IN BRANS AND DICKE'S SCALAR−TENSOR THEORY. Dehnen, H.; Obregon, O. (Univ., Konstanz, Ger.). Astrophys. Space Sci.; 17: No. 2, 338-342(Aug 1972).

The exact cosmological vacuum solutions of Brans and Dicke's scalar−tensor theory are derived when a power law is valid between the gravitational constant k and the radius of curvature R of the Universe. There exist even in the case of the closed 3-dimensional space of positive curvature solutions with increasing R and k with respect to the age of the Universe, whereby the freely available parameter ω of the scalar−tensor theory can take all values greater than $-\frac{3}{2}$. Such solutions are contrary to Dirac's hypothesis as well as to Einstein−Mach's principle. (auth)

9128 RELATIVISTIC NON-ZERO PRESSURE COSMOLOGY. Sistero, R. F. (Univ. Nacional, Cordoba, Argentina). Astrophys. Space Sci.; 17: No. 1, 150-160(Jul 1972).

A further extension of the theory of interacting matter−radiation

cosmological models is presented. The neutrino contribution to the radiation field is explicitly included. A discussion and interpretation of the observables within the theory is given. Mean evolutionary corrections for galaxies are shown to be implied by these models. Finally, as an example a cosmological interpretation of quasars is presented. (auth)

9129 SOME IMAGES PRODUCED BY GRAVITATIONAL LIGHT DEFLECTION. Christensen, R. (Arthur D. Little, Inc., Cambridge, MA). Nuovo Cim.; 15B: No. 1, 69-76(11 May 1973).

Some images produced as a result of gravitational light deflection by bodies other than the Sun are discussed. Two cases are examined, when the source is much more distant than the intervening body, and when it is relatively near to the intervening body. A disc source, for example, can have a disc image with a bright bulge on one edge, a distorted ring image, or even a double-component image with both components of equal brightness but one smaller than the other. The two components of a double image can have apparent relative velocities exceeding the speed of light, and this is suggested as a possible explanation of observations of the quasar 3C 279. (auth)

9130 HOOKE'S SYMMETRIES AND NONRELATIVISTIC COSMOLOGICAL KINEMATICS. II. IRREDUCIBLE PROJECTIVE REPRESENTATIONS. Dubois, J. G. (Univ. of Quebec, Rimouski). Nuovo Cim.; 15B: No. 1, 1-17(11 May 1973).

The irreducible unitary projective representations of the Hooke groups are constructed by Mackey's method of induced representations. In this manner, a classification of the true irreducible representations of the extended and ordinary Hooke group universal covering and a classification of the elementary quantum systems which have Hooke symmetries are obtained. The eigenvalues of their invariant operators label these irreducible representations, and the corresponding infinitesimal representations define their Lie algebras. When this makes sense, some physical interpretations are given. (auth)

9131 PREFERRED ORIENTATION OF EXTRAGALACTIC DOUBLE RADIO SOURCES. Thiel, M. A. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Space Sci.; 17: No. 1, 39-47(Jul 1972).

The distribution of the main axes of double radio sources was used to test isotropy of that part of the Universe which is accessible to radio investigations. Data for 274 double and/or extended sources were taken from the literature to compute the fit to several simple models of global orientation by means of a χ^2-test. The best fit was found on a 3%-significance level for the preferred orientation along a right-handed helix with pitch angle 82° in the direction $\alpha = 95°$, $\delta = -38°$ ($l \cong 65°$, $b = \cong 20°$). This preferential alignment of radio sources is assumed to be caused by a large-scale magnetic field. (auth)

9132 COSMOLOGICAL MODEL ILLUSTRATING PARTICLE CREATION THROUGH QUANTUM GRAVITON PRODUCTION. Berger, B. K. College Park, MD; Univ. of Maryland (1972). 229p. University Microfilms Order No. 73-9674.

Thesis (Ph.D.).

A spatially inhomogeneous, anisotropic, exact solution of Einstein's equations for which quantization leads to the production of gravitons from empty space is discussed. The creation of pairs of gravitons occurs in wave modes with wavelength exceeding the horizon size at an initial time. The final number of created gravitons and the cut-off mode above which no gravitons are produced depend strongly on the choice of initial time. At large times, one can express the solution in WKB form so that the graviton number is well defined. For the initial state an N-quantum eigenstate or random-phase mixture of eigenstates, no gravitons with wavelength shorter than the horizon size at the initial time are created. The final number of created particles in any mode is proportional to the number of causally unconnected regions at the initial time over the wavelength of that mode. Below the cut-off mode, the energy spectrum of the created gravitons is flat. The quantum graviton creation produces the anisotropic collisionless gravitational radiation which characterizes the large time classical solution. For large times, this solution is identical to that found by Doroshkevich, Zel'dovich, and Novikov for collisonless radiation moving along only one spatial axis. Near the singularity, the model behaves like an empty Bianchi Type I universe at each point in space (local Kasner). The character of the anisotropy evolves from anisotropic empty space at early times to anisotropic collisionless gravitational radiation at large times. It is believed that the introduction of graviton–graviton interactions, absent (by symmetry) from this model, could lead to rapid isotropization of the radiation. The model considered is a well known Einstein–Rosen gravitational wave solution which Gowdy first interpreted as a closed universe having 3-torus topology. The canonical methods of Arnowitt, Deser, and Misner are used to obtain a reduced Hamiltonian from which the classical equations of motion are obtained, and with which system is quantized. (Diss. Abstr. Int., B)

9133 EVOLUTION OF FRIEDMANN MODELS WITH RADIATION. Edwards, D. (Thames Polytechnic, London). Astrophys. Space Sci.; 18: No. 1, 40-48(Sep 1972).

The evolution of uniform cosmological models containing both matter and radiation and with nonzero cosmological constant is examined. Models are specified by means of three fundamental parameters and are represented by points in a three dimensional space. (auth)

9134 COMPARATIVE STUDY OF BRANS–DICKE AND GENERAL RELATIVISTIC COSMOLOGIES IN TERMS OF OBSERVATIONALLY MEASURABLE QUANTITIES. Barnes, R. C.; Prondzinski, R. (Univ. of Missouri, Columbia). Astrophys. Space Sci.; 18: No. 1, 34-39(Sep 1972).

A comparison between general relativistic and Brans – Dicke cosmologies is made in terms of quantities measurable by an observational astronomer. Numerical integration of the Brans–Dicke field equations was employed to find the relationships of the mean density of cosmic matter, the age, and the time derivative of the gravitational constant to the Hubble constant and deceleration parameter. The difference between general relativistic and Brans–Dicke apparent magnitude–redshift diagrams was found to be negligible even at large redshifts under the assumption of no galactic evolution in absolute magnitude. (auth)

9135 PRODUCTION OF METAGALACTIC X RAYS BY RELATIVISTIC DUST GRAINS. Hayakawa, S. (Nagoya Univ., Japan). Astrophys. Space Sci.; 19: No. 1, 173-179(Nov 1972).

The relativistic dust grains which may be responsible for ultra-high energy cosmic rays, as suggested by the present author, interact with the cosmic blackbody radiation. This results in the energy loss of the relativistic dust grains, so that their energy spectrum is cut-off at the Lorentz factor as large as 2×10^3 ($0.1\ \mu/a$), where a is the grain radius. The blackbody radiation is scattered and absorbed by the dust grains. The photons scattered and reemitted contribute to metagalactic x rays. The x-ray intensity estimated is comparable to the observed one in the soft x-ray region. (auth)

9136 POSSIBILITY OF MEASURING GRAVITATIONAL REDSHIFT BY MEANS OF EARTH SATELLITES. Korchak, A. Comments Astrophys. Space Phys.; 5: No. 2, 37-42(1973).

Consideration is given to the examination of gravitational frequency shift to check one of the consequences of the general theory of relativity. It is stated that application of satellites makes it possible to displace the equipment in the Earth's gravitational field from one point to another, and the use of frequency standards provides a record of the relative shift $\Delta f/f \lesssim 10^{-12}$. Various methods have been suggested of cancelling out the obscuring effect of first-order Doppler shift, because it is approximately five orders greater than the expected value of the gravitational shift, which is approximately 10^{-13} per km of height near the Earth. Methods are discussed for the exchange of signals between ground stations and satellites, pointing out the aims and difficulties in carrying out the experiments, and possible future developments are mentioned. (UK)

9137 EXTENDED EXTRAGALACTIC RADIO SOURCES. De Young, D. S.; Burbidge, G. (National Radio Astronomy Observatory, Green Bank, WV). Comments Astrophys. Space Phys.; 5: No. 2, 29-36(1973).

It is stated that extended extragalactic radio sources have their origin in the energy released in the nucleus of a galaxy or QSO and in some way ejected from this region. An account is given of the various proposals which have been made which try to account for the form of the extended sources. The most important feature is the double structure characterized in an ideal (theoretical) model by two extended radio-emitting regions situated symmetrically about the nucleus of an optical galaxy or QSO. Not all extended radio sources show this structure: some have a core–halo structure. The major problems are (1) how double structures and core–halo structures are generated and (2) how they are maintained for significant periods $\geq 10^6$ years, far outside the optical objects in which they originated. Theoretical proposals for the containment of extended double sources have relied upon self-gravitation of the ejected material or upon assuming the existence of a gaseous intergalactic medium. These proposals are discussed. Consideration is also given to the nuclear event — in order to release the energy required to make an extended source it is assumed that a highly condensed object is present in the nucleus of the galaxy or QSO or that matter is being created in these regions. (UK)

9138 SINGULARITY AND MATTER CREATION COSMOLOGICAL MODELS. Narlikar, J. V. (Tata Inst. of Fundamental Research, Bombay). Nature (London) Phys. Sci.; 242: No. 122, 135-136(30 Apr 1973).

It is stated to be a reasonable assumption that the singularity present in the classical Friedmann cosmological models, and in the gravitational collapse of massive objects, is an unavoidable consequence of general relativity. Singular solutions are as a rule unpopular with theoreticians and suggest something wrong with theory. Some cosmologists, however, argue that the cosmological singularity describes an unusual event, the creation of the Universe, and should not be judged by the usual yardstick. This argument however, cannot be applied to collapsing massive objects. An unsatisfactory feature of classical cosmological models is the scant attention paid to matter creation. It is assumed that all the present matter, and radiation, in the Universe appeared in a primary form at the time of the "big bang", and subsequent to this event matter as a whole has been conserved according to the Einstein equations, although it may change its form as the Universe evolves. Thus the question of how matter was created in the first place is left unanswered. It is suggested that drawbacks in classical cosmological discussions may be connected and that a proper consideration of matter creation should resolve the problem of singularity. Two cosmological models are discussed in which explicit discussion of matter creation has led to the removal of singularity; the first is the well known "steady-state" model, and the second is a singularity-free Friedmann model. In the "steady-state" model a singular state does not exist, and matter is created continually, whilst in the nonsingular Friedmann model matter is created once and for all in an instant. If overall energy conservation is to be maintained primary matter creation must be accompanied by release of negative energy, and the repulsive nature of the negative energy reservoir will be sufficient to prevent the singularity; this conjecture should apply to finite collapsing objects as well as to the Universe. (UK)

9139 RESTRICTIONS ON THE SHORT TIME CONSTANT ASTROPHYSICS. Cavallo, G.; Ventura, A. (Radiazioni Extraterrestri, Bologna). Astrophys. Space Sci.; 19: No. 2, 431-439 (Dec 1972).

The comparatively new field of short time-constant astrophysics is investigated with the aim of checking the statement that there is a maximum amount of electromagnetic energy which can be radiated at a frequency ν_m by an object whose size is L and during a time $\Delta\tau$. Such limits are found under the assumptions that the emission is isotropic, that $L \simeq c\Delta\tau$, and for the following four radiation mechanisms: incoherent synchrotron radiation, synchrotron maser, antenna radiation, and for one simple case of radiation by a turbulent plasma. These limits are compared and found to be consistent with experimental data referring to the Sun, the pulsar NP 0532, the Quasar 3C 273, and the Seyfert galaxy NGC 4151. The main conclusion is that extragalactic radio astronomy at the present sensitivity level of observations is not likely to allow for the detection of pulses lasting less than 0.1 s. (auth)

9140 ROTATIONAL PERTURBATIONS IN THE FRIEDMANN COSMOLOGICAL MODEL. Zel'dovich, Ya. B.; Novikov, I. D. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 6: No. 3, 203-206(1970).

Translated from Astrofizika; 6: No. 3, 379-385(1970).

The physical reasons for the unbounded growth of the turbulent perturbations of the metric which occurs for $t \to 0$ in the case of a time-independent, small velocity of rotational perturbations is discussed. It is shown that the growth of the perturbations is connected with the increase in the anisotropy of the Hubble expansion for $t \to 0$. The degree of deformation anisotropy divided by the degree of isotropic expansion is of the order of (V/c) (l/ct), where l is the perturbation scale. If one assumes, in accordance with the turbulence theory of formation of galaxies, that at the time of hydrogen recombination the velocity of rotational perturbations on the scale of the optical horizon $M \approx 10^{17} M_\odot$ is $V/c \approx 10^{-4}$, then for $t < 10^5$ sec the solution should be substantially different from the Friedmann solution. (auth)

9141 DO NUMBER COUNTS TELL US ANYTHING ABOUT THE DISTRIBUTION OF DISTANT SOURCES? Carswell, R. F. (Univ. of Arizona, Tucson). Mon. Notic. Roy. Astron. Soc.; 162: No. 1, 61-72(1973).

The C^- method for finding the spatial distribution of radio sources requires knowledge of both the flux and redshift for each source, while source counts yield little information on the detailed distribution but do not require time consuming redshift determinations. The possibility of obtaining an approximate density evolution using a log N–log S related method with redshift information from a subsample is examined in some artificial cases with the hope that something better than a $(1 + z)^n$ type law may be found. It appears that for realistic models there is little information on the evolutionary behavior at large redshifts, and a rough criterion for when this is true is given. (auth)

Planetary Phenomena

9142 PERIODICITIES IN THE JOVIAN DECAMETRIC EMISSION. Kaiser, M. L.; Alexander, J. K. (Goddard Space Flight Center, Greenbelt, MD). Astrophys. Lett.; 14: No. 1, 55-58(1973).

The power spectrum from nearly 17 yr of 22-MHz observations of Jupiter's decametric emissions was examined in order to investigate the effect of modulation by the planet's five innermost satellites and to determine the periodicities of long-term phenomena possibly associated with solar activity or Earth–Jupiter geometry effects. Whereas Io apparently stimulates a radio storm every 13 hr upon successive sweeps of a given Jovian longitude, no comparable effects due to other satellites can be detected. Both the apparent decametric rotation period and the occurrence probability statistics are modulated with a period of about 12 yr (one Jovian yr) and are not substantially influenced by the solar cycle (~10.5 yr). Any short-term solar influence on the decametric emission does not appear in the power spectrum at periods between 25 and 26 days, as would be expected for recurrent phenomena associated with rotation of solar active regions. (auth)

9143 FORMATION OF JUPITER. Kumar, S. S. (Univ. of Virginia, Charlottesville). Astrophys. Space Sci.; 16: No. 1, 52-54(Apr 1972).

Arguments are presented to show that Jupiter could not have been formed as a star of mass 0.001 $M_\odot$ and that the observed excess energy is not due to gravitational contraction from an extended, gaseous state. (auth)

9144 EFFECTS OF VISCOUS FRICTION ON AXIAL ROTATION OF CELESTIAL BODIES. Kopal, Z. (Lunar Science Inst., Houston, TX). Astrophys. Space Sci.; 16: No. 1, 3-51(Apr 1972).

An attempt is made to formulate explicitly the differential equations which govern three-dimensional rotation of deformable self-gravitating bodies of arbitrary structure, and consisting of fluid material whose viscosity is an arbitrary function of spatial coordinates; with special respect to a description of the effects of viscous friction exhibited in binary systems which consist of a close pair of such configurations. (WDM)

9145 EFFECTS OF VISCOUS FRICTION ON THE PRECESSION AND NUTATION OF CELESTIAL BODIES. Kopal, Z. (Lunar Science Inst., Houston, TX). Astrophys. Space Sci.; 16: No. 3, 347-371(Jun 1972).

An attempt is made to set the system of differential equations which govern the precession and nutation of self-gravitating globes of compressible viscous fluid, due to the attraction exerted on the rotating configuration by its companion; and to construct their approximate solution which is correct to terms of the second order in small dependent variables of the problem. (WDM)

9146 FLUORINE IN LUNAR SAMPLES: IMPLICATIONS CONCERNING LUNAR FLUORAPATITE. Reed, G. W.; Javanovic, S. (Argonne National Lab., IL). Geochem. Cosmochim. Acta; 37: No. 6, 1457-1462(Jun 1973).

The F contents of a number of Apollo 14 and 15 samples range from less than a ppm for anorthosite rock fragments to 165 ppm for some soils and breccias. Apollo 15 soils tend to have lower F contents (50 to 70 ppm) than soils from other sites. In most cases samples were run simultaneously with W-1 in which F was determined to be 216 (±11) ppm. Photon activation analysis is the technique used (Reed and Jovanovic, Earth Planet. Sci. Lett.; 6: 316-320 (1969)). Powdered samples, 30 to 100 mg sealed in silica tubes of 2 to 3 mm i.d., were irradiated along with monitors of PVF (polyvinylfluoride). The F/F_2O_5 ratio is 0.032 ± 0.005 in soils and rocks. A correlation exists in soils between F, P_2O_5, and that fraction of the Cl which is insoluble in hot water. The F/Cl_r ratio in soils and rocks, though different, requires that the phosphate phase involved be fluorapatite; this is consistent with mineralogical observations. F, like Cl, is correlated with KREEP elements at all sites for which data are available. (auth)

9147 VOLATILE ELEMENTS IN APOLLO 16 SAMPLES: POSSIBLE EVIDENCE FOR OUTGASSING OF THE MOON. Krahenbuhl, U.; Ganapathy, R.; Morgan, J. W.; Anders, E. (Univ. of Chicago). Science; 180: No. 4088, 858-861(25 May 1973).

Several Apollo 16 breccias, including one containing goethite,

are strikingly enriched in volatile elements such as bromine, cadmium, germanium, antimony, thallium, and zinc. Similar but smaller enrichments are found in all highland soils. It appears that volcanic processes took place in the lunar highlands, involving the release of volatiles including water. The lunar thallium/uranium ratio is 2×10^{-4} of the cosmic ratio, which suggests that the Moon's original water content could not have exceeded the equivalent of a layer 22 meters deep. The cataclastic anorthosites at the Apollo 16 site may represent deep ejecta from the Nectaris basin. (auth)

9148 OBSERVATIONS OF ATMOSPHERIC LIMB DARKENING IN THE VISUAL CONTINUUM AND AN ANALYSIS OF MULTIPLE SCATTERING IN THE ATMOSPHERES OF JUPITER AND SATURN. Smith, B. A. University Park, NM; New Mexico State Univ. (1972). 180p. University Microfilms Order No. 73-10,372.

Thesis (Ph. D.).

Atmospheric limb darkening of optically homogeneous belts and zones on Jupiter and Saturn was measured in the visual continuum over a range of spectral passbands and phase angles for the years 1969–1971. Both Jupiter and Saturn exhibited surface brightness distributions that were consistent with anisotropic scattering in a semi-infinite cloud layer, but the observations also suggest the presence of an optically thin layer of small particles overlying the dense cloud surface on Saturn. The shape of the scattering indicatrix of particles in the Jovian cloud surface in 1971 varied only slightly from place to place and, in general, indicated slightly forward scattering. The observed variations were unrelated to color or albedo. In the shorter wavelengths only, the cloud particles in both the northern and southern hemispheres of Jupiter in 1969 showed backscattering characteristics. On Saturn in 1970 all observable regions of the southern hemisphere indicated rather strong backscattering properties with no detectable variation in the shape of the scattering indicatrix from one zonal feature to another. Predictions of surface brightness distributions from the multiple scattering models are given for typical cloud features on Jupiter and Saturn at large phase angles. (Diss. Abstr. Int., B)

9149 RADIOACTIVE ELEMENTS IN VENUSIAN ROCK. Results of the Venera-8 Space Probe Experiment. Vinogradov, A. P.; Surkov, Yu. A.; Kirnozov, F. F.; Glazov, V. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 3, 576-579(21 Jan 1973). (In Russian).

A gamma spectrometer which was transported to Venus by the spaceship Venera-8 in July 1972 was used to obtain an energy spectrum of Venusian rock, obtaining maxima at 0.9, 1.46, 1.76, and and 2.62 MeV. These were interpreted as the decay of K, U, and Th, the corresponding quantitative values in content being 4%, 2.2×10^{-4}%, and 6.5×10^{-4}%, after making allowance for the denser atmosphere on Venus. The metamorphic character of the rock and the evolution of the solar system are discussed in the light of these new data. (KSW)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 8981.

9150 (AD-751235) AIRBORNE DETERMINATION OF ARCTIC IONOSPHERE CROSS SECTIONS. Gassmann, G. J.; Gowell, R. W.; Pike, C. P.; Wagner, R. A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 5 Sep 1972. 33p. (AFCRL-72-525; AFCRL-ERP-412). NTIS.

From June 3 to 20, 1972 the airborne ionospheric laboratory was stationed in RAF Mildenhall, England, for the purpose of obtaining realistic ionization cross sections suitable for assessing hf propagation conditions in the Arctic. A number of quasi-instantaneous cross sections for various hours during local night of five different days were produced, however limited to low magnetic activity, except for one PCA event, and limited to the area north of England. The results provide a three dimensional representation of the ionosphere along a 7 degree wide azimuth range. (auth) (NTIS)

9151 (AD-751921) ADVECTIVE HEATING IN THE THERMOSPHERE DURING GEOMAGNETIC STORMS. Forbes, J. M. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 14 Sep 1972. 15p. (AFCRL-72-552; AFCRL-ERP-414). NTIS.

A scale analysis is performed to estimate the meridional wind speeds necessary to effectively redistribute thermal energy by advection to lower latitudes during geomagnetic storms. Winds on the order of several hundreds of meters per second are found to account for a considerable amount of heat transfer in the thermosphere. Meridional winds of this magnitude during geomagnetic storms were reported by several workers. (auth) (NTIS)

9152 (AD-752060) INDUCED ENHANCEMENT OF THE PLASMA LINE IN THE BACKSCATTER SPECTRUM BY IONOSPHERIC HEATING. Technical Report No. 5, January–June 1972. Harker, K. J. (Stanford Univ., Calif. Stanford Electronics Labs.). Jun 1972. Contract N00014-67-A-0112-0066. 15p. (SU-SEL-72-41). NTIS.

Recent results from ionospheric modification experiments at the Arecibo Ionospheric Observatory show an enhanced plasma line temperature of approximately 4000°K due to excitation of the ion-acoustic parametric instability. Recent theories on the saturation spectrum of the plasma waves excited in this experiment predict that the bulk of the wave energy is associated with waves propagating in a very narrow angular cone centered on the geomagnetic field. The intensity of the plasma waves responsible for the scattering, propagating parallel to the probing radar beam i.e., at 40 to the geomagnetic field, is orders of magnitude weaker than the intensity of the parallel propagating plasma waves. It is shown that it is still sufficient to account for the experimental results. (auth) (NTIS)

9153 (AD-752163) CONVECTIVE AMPLIFICATION OF TYPE I IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Lee, K.; Kennel, C. F. (California Univ., Los Angeles. Plasma Physics Group). Nov 1972. Contract N00014-69-A-0200-4023. 42p. (PPG-136). NTIS.

Wave propagation and refraction of Type I irregularities in the equatorial electrojet were investigated. Quantitative calculation of wave refraction in a model electrojet showed that the direction of wave refraction must change sign at one altitude. Waves propagating with the electrons rotate their wave vectors upward in the upper electrojet and downward in the lower electrojet during the day, and vice versa at night. Furthermore, the altitude region of largest linear growth rate is also the one with the weakest refraction rate. Consequently computations of the ray-path integrated wave growth shows that this region would dominate the backscatter spectrum from the electrojet if linear were valid, and it is further noted that the maximum amplitude wave should have phase velocities exceeding the ion acoustic speed. It is concluded that propagation alone, without inclusion of nonlinear effects, cannot explain backscatter observations of a constant Doppler frequency shift given by the ion acoustic speed. (auth) (NTIS)

9154 (AD-755839) GEOPHYSICS AND SPACE DATA BULLETIN. Volume 9, Number 3. Third Quarter, 1972. Carrigan, A. L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Dec 1972. 296p. (AFCRL-72-707; AFCRL-SR-149). NTIS.

The Bulletin is a quarterly publication that contains AFCRL contract and inhouse data reported from sites throughout the world. The following types of data are contained within each issue: magnetometer, cosmic ray, elf noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for July, August, and September 1972. (auth) (NTIS)

9155 (N-73-16340) CONVECTIVE AMPLIFICATION OF TYPE 1 IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Lee, K.; Kennel, C. F. (California Univ., Los Angeles. Plasma Physics Group). Nov 1972. Contract N00014 69-A-0200-4023. 41p. (NASA-CR-130382; PPG-136). NTIS.

Wave propagation and refraction of Type 1 irregularities in the equatorial electrojet were investigated. Quantitative calculation of wave refraction in a model electrojet showed that the direction of wave refraction must change sign at one altitude. Waves propagating with the electrons rotate their wave vectors upwards in the upper electrojet and downwards in the lower electrojet during the day, and vice versa at night. Furthermore, the altitude region of largest linear growth rate is also the one with the weakest refraction rate. Consequently, computations of the ray-path integrated wave growth shows that this region would dominate the backscatter spectrum from the electrojet if linear theory were valid, and it is further noted that the maximum amplitude wave should have phase velocities exceeding the ion acoustic speed. It was concluded that propagation alone, without inclusion of nonlinear effects, cannot explain backscatter observations of a constant Doppler frequency shift given by the ion acoustic speed. (auth) (STAR)

9156 RADIATION PROCESSES IN THE ATMOSPHERE. Second IMO Lecture. Kondrat'ev, K. Ya. WMO No. 309. New York; UNIPUB, Inc. (1972). 243p. $20.50.

Topics covered in detail in this review include: the solar constant; radiation characteristics of the underlying surface; radiation climatology of the Earth; atmospheric aerosols and their influence on radiation transfer; and radiation, thermal regime, and dynamics of the atmosphere. (WDM)

9157 DEPENDENCE OF THE LENGTH OF AURORAL RAYS ON AURORAL ACTIVITY LEVEL. Bliznyuk, N. N.; Dzyubenko, N. I. (Kiev State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 820(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 944(1972).

It is concluded that the expected dependence of auroral ray lengths on the preceding auroral activity level is very definite. The obtained dependence of ray length on total auroral activity agrees with the hypothesis of a substantial heating and increase of the height scale of the upper atmosphere during auroras. (WDM)

9158 CHARACTERISTICS OF HORIZONTAL DRIFTS OF INHOMOGENEITIES IN THE LOWER IONOSPHERE NEAR THE EQUATOR. Babadzhanov, P. B.; Rubtsov, L. N.; Solovey, B. G. (Astrophysical Inst., Dushanbe, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 814-815(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 938(1972).

In constructing a global map of atmospheric circulation, measurements near the equator are of particular importance since this region is unique in its wind regime characteristics and has an insufficient number of observation points. The results of the Soviet equatorial meteoric expedition to the Republic of Somali Mogadiscio, (ϕ = 10°S) are discussed and compared with observations made at other stations of the region near the equator. (WDM)

9159 HORIZONTAL DIMENSIONS OF VERTICALLY TRAVELING IONOSPHERIC DISTURBANCES. Vasil'ev, K. N.; Grishkevich, L. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 815-817(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 939-940(1972).

A review of experimental results for the long base ($L \geq 400$ km) and short base ($L < 100$ km) shows that in the F2 layer vertically travelling ionospheric disturbances have relatively limited dimensions (of the order of hundreds of kilometers). (WDM)

9160 POSSIBILITY OF OBSERVING THE DECAY INTERACTION OF PLASMA WAVES IN TOPSIDE SOUNDING EXPERIMENTS. Vas'kov, V. V.; Gusev, G. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 800-801(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 924(1972).

Analysis of resonance phenomena in ionospheric topside sounding shows that the decay interaction of plasma waves can be ob-

served and utilized as a valuable diagnostic tool. The decay process for three longitudinal waves is examined. (WDM)

9161 VERTICAL PROFILES OF THE EFFECTIVE COLLISION FREQUENCY IN THE E AND F REGIONS OF THE IONOSPHERE. Shlionskii, Sh. G.; Soboleva, T. N.; Leshchinskaya, T. Yu. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 801-803(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 925-926(1972).

The effective collision frequency was calculated for winter during the solar activity minimum of 1965 ($K_p < 2$) for noon and midnight using models of the vertical-latitudinal distribution of parameters obtained by generalizing and averaging the results of various experiments. (WDM)

9162 SPATIAL STRUCTURE OF THE E_s-LAYER. Ovezgel'diev, O. (Inst. of Terrestrial and Atmospheric Physics, Ashkhabad, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 803-804(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 927(1972).

To study the spatial structure of the sporadic E-layer during the summers of 1966-69, spaced soundings with separations $\Delta l = 18$, 120 and 338 km were carried out with two identical ionospheric stations of type AIS. The total duration of the continuous simultaneous measurement sessions was over 500 hr. In addition, experimental data obtained at IZMIRAN in 1967 were used for simultaneous sounding at all three points $\Delta l < 100$ km apart. Measurements at the separated points were made under continuous conditions according to a single program, and the simultaneity of the measurement was achieved with an accuracy ~20 sec. The successive values of the limiting reflection frequency f_bE_s (determined by the fine structure of the layer and blanketing frequency f_b E_s (which determines the maximum electron density of the layer) were determined every 40 sec. (WDM)

9163 VERTICAL ELECTRON DENSITY DISTRIBUTION AT THE GEOMAGNETIC POLE IN THE NORTHERN HEMISPHERE (FROM DATA OF TOPSIDE AND GROUND-BASED SOUNDINGS OF THE IONOSPHERE). Kolomiytsev, O. P.; Pushkova, G. N.; Yudovich, L. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 805-807(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 928-930(1972).

An attempt was made to plot a complete vertical profile of the electron density $n_e(h)$ in the F region of the ionosphere at high latitudes of the northern hemisphere in winter, and to study the ionization sources of the upper ionosphere during periods when the atmosphere at the F-region level is in the shadow. The $n_e(h)$ profile was plotted from data of simultaneous topside (Alouette 1) and bottomside (ground stations) soundings of the ionosphere in November-December 1964. Stations at a distance of not more than 500 km from the projection of the satellite's orbit on the earth were selected. (WDM)

9164 THREE-COMPONENT STATIC MODEL OF THE THERMOSPHERE. Gridchin, G. V.; Ivanovskii, A. I.; Marchevskii, V. A.; Repnev, A. I. (Central Aerological Observatory, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 754-758(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 871-876(1972).

A static model of the thermosphere, consisting of O, O_2, and N_2, is analyzed. It is used to estimate the radiative recombination coefficient of atomic oxygen, elucidate the relative effect of the lower boundary conditions of density and temperature, and also to estimate the role of heat sources and sinks, and of the effect of diffusion and thermal diffusion. The quantitative relationship between ionizing solar radiation and solar radio noise at a wavelength of 10.7 cm is determined. (auth)

9165 DIFFUSION OF WEAK INHOMOGENEITIES IN A MAGNETICALLY ACTIVE PLASMA CONSISTING OF TWO IONS. Gunzburg, E. I.; Kim, V. F. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 735-741(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 849-856(1972).

The nature of diffusion of weak inhomogeneities in a two-ion magnetically active plasma of arbitrary degree of ionization is investigated. It is demonstrated that the initial charged-particle distribution breaks down into two groups: electron and ion, which spread with their own characteristic times. Different limiting cases are examined and their diffusion characteristics are written in explicit form. Ambipolar diffusion equations are obtained, which in some cases can be reduced to the usual form of diffusion equations. (auth)

9166 FORMATION OF THE MIDDLE-LATITUDE E_s-LAYER UNDER THE EFFECT OF WIND SHEAR WITH ALLOWANCE FOR TWO KINDS OF IONS. Ignat'ev, Yu. A.; Nesterov, V. P.; Chasovitin, Yu. K. (Inst. of Experimental Meteorology, Obninsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 730-734(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 843-848(1972).

Expressions are obtained on the assumption of the existence of two kinds of ions in the ionosphere that make it possible to compute the vertical density distribution of electrons and ions from an experimental wind velocity profile. The computed electron density profile is compared with the experimental one. (auth)

9167 CORRELATIONS BETWEEN X RAYS AND IONIZING ULTRAVIOLET RADIATION IN THE E REGION, ACCORDING TO DATA FROM THE SOLAR ECLIPSE OF FEBRUARY 25, 1971. Gogosheva, Ts.; Kazakov, K.; Serafimov, K. (Geophysical Inst., Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 725-729(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 836-842(1972).

The data from Sofia and Michurin stations were used in an analysis of the change in maximum electron densities in the E layer during the solar eclipse of February 25, 1971. Good agreement between the observed values and the theoretical model was obtained if 40% of the total ionization was produced by the emission of the inhomogeneous corona, which generally follows the distribution of the green coronal 5300 Å line. The conclusion was derived from a comparison of this result with data for other eclipses that the contribution of soft x rays to E-layer ionization increases with solar activity (from ~27% for $R \approx 45$ to 40% for $R = 93$). The fine structure of the E-layer revealed more intense stratification during an eclipse. The effective recombination coefficient amounted to $\alpha_{eff} \approx 8.5 \cdot 10^{-8}$ cm^3 sec^{-1} and varied little during an eclipse. (auth)

9168 RADIO-WAVE POLARIZATION DURING PARTIAL SCATTERING. Berezin, Yu. V.; Matiyasevich, N. A.; Smirnov, V. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 720-724(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 830-835(1972).

The distribution law of the polarization characteristics $W(p,\Delta)$ of a partly scattered wave is obtained and analyzed. Formulas are presented that define the parameters of the distribution law $W(p,\Delta)$ and their physical interpretation is given. The results obtained are used to analyze the polarization fluctuations of a wave reflected from the ionosphere during vertical sounding. The conditional theoretical and experimental laws of distribution of polarization characteristics are compared. Numerical estimates are given of the parameters of the distribution law $W(p,\Delta)$. (auth)

Effects of Nuclear Detonations

9169 NEUTRON DIFFUSION FROM A DISTRIBUTED SOURCE IN AN INHOMOGENEOUS ATMOSPHERE. Levitskaya, G. V. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 796-798(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 920-921(1972).

Diffusion from a three-dimensional source of thermal neutrons formed in the course of thermalization of fast neutrons is considered. The source of fast neutrons is assumed to be stationary and planar. (WDM)

Magnetospheric Phenomena

Refer also to abstracts 8882 and 8894.

9170 (AD-752061) GENERATION OF ARTIFICIAL GEOMAGNETIC MICROPULSATIONS WITH A LARGE GROUND-BASED CURRENT LOOP. Technical Report, January 1971–June 30, 1972. Fraser-Smith, A. C.; Harker, K. J.; Bly, R. T. Jr.; Bubenik, D. M. (Stanford Univ., Calif. Stanford Electronics Labs.). Jun 1972. Contract N00014-67-A-0112-0066. 95p. (SU-SEL-72-23). NTIS.

The purpose of this study was to investigate and, if possible, establish the feasibility of producing artificial geomagnetic micropulsations by using a large horizontal current loop on the ground. Most natural micropulsations appear to be produced by hydromagnetic (hm) waves propagating in the ionosphere and/or the magnetosphere, and the term "artificial micropulsations" is used to mean artificially produced hm waves with propagation characteristics similar to those of the natural signals. The critical quantity in the generation process for the hm waves is to the amplitude of the magnetic field variation that can be produced in the ionospheric E region by the ground-based loop. Currents are induced in the conducting Earth beneath the loop whenever its current is varied, and these currents have a magnetic field opposing the magnetic field of the loop. If either the conductivity of the Earth or the variation frequency is too high the

field at E region heights may be reduced to a level where negligible hm wave amplitudes are produced. The effect of these Earth currents is calculated for an assumed single-layer Earth and for a wide range of frequencies and Earth conductivities. (auth) (NTIS)

9171 (AD-754844) OBSERVATIONS OF RING-CURRENT PROTONS AT LOW ALTITUDES. Research Report, April–July 1972. Mizera, P. F.; Blake, B. (Aerospace Corp., El Segundo, Calif.). 12 Jan 1973. Contract F04701-72-C-0073. 23p. (SAMSO-TR-72-317). NTIS.

Variable intensities of geomagnetically trapped protons with energies between 12.4 and 500 keV were observed during times encompassing the magnetic storms on March 20 and 24, 1969. These proton fluxes were measured for $1.0 < L < 1.1$ near the magnetic equator, at local midnight with solid-state detectors and an electrostatic analyzer on the low-altitude satellite OV1-17. The OV1-17 observations of proton intensities with $E > 200$ keV are in substantial agreement with similar measurements taken with the AZUR satellite and reported recently by Moritz (Zeitschrift fur Geophysik, in press 1972). Further, the lower energy proton intensities, measured with OV1-17 instrumentation, support Moritz's suggestion that the source of these low-altitude protons is the ring current. (NTIS)

9172 (AD-755352) PRECIPITATION OF AURORAL AND RING CURRENT PARTICLES BY ARTIFICIAL PLASMA INJECTION. Cornwall, J. M. (Aerospace Corp., El Segundo, Calif.). 30 Jan 1973. Contract F04701-72-C-0073. 28p. (SAMSO-TR-72-316). NTIS.

Outside the plasmasphere, most of the energy in magnetospherically trapped particles resides in two populations: auroral-energy electrons, and the proton ring current, with single-particle energies from 1 to 50 keV. The ring current contains more energy than all other components of the magnetospherically trapped radiation. It may be possible to precipitate a large fraction of this energy into the ionosphere by injection of a light-ion plasma from a synchronous satellite, which would render the ring current protons unstable to a variety of plasma modes. (auth) (NTIS)

9173 (AD-755901) EFFECTS OF PHOTOELECTRON EMISSION ON A MULTIPLE-PROBE SPACECRAFT NEAR THE PLASMAPAUSE. Report for November 1971–September 1972. Cauffman, D. P. (Aerospace Corp., El Segundo, Calif.). 1 Dec 1972. Contract F04701-72-C-0073. 23p. (SAMSO-TR-72-318). NTIS.

Measurements of the potential difference between a pair of symmetrical, spherical, floating probes (14-cm diameter, 5-m baseline) flown on the S(3)-A (Explorer 45) spacecraft (launched November 1971, with apogee 5.2 (R_e), perigee 222 km, and inclination 3.6 deg) have shown a complicated response to sheath potentials in the region near and inside the plasmapause. Typically, with increasing altitude (1) the sunward sphere will first assume a more negative potential than the antisunward sphere, (2) the polarities of the probes in the region $L = 2$ to 4 may switch, sometimes several times, and (3) finally, the detector output may saturate (delta phi > 125 mV) with the sunward sphere more negative again. (auth) (NTIS)

9174 (N-73-14743) THEORETICAL AND EXPERIMENTAL STUDIES OF THE NATURE AND CHARACTERISTICS OF SPACE RELATED PLASMA RESONANCE PHENOMENA. Semiannual Report, 1 January–30 June 1972. Crawford, F. W. (Stanford Univ., Calif. Inst. for Plasma Research). Sep 1972. 30p. (NASA-CR-129915; SU-IPR-492). NTIS.

Theoretical and experimental studies of space related plasma wave propagation and resonance phenomena cover whistler emissions and instabilities, low frequency plasma instabilities, nonlinear wave interactions and scattering from plasma column, and the resonance cone of dipole antenna immersed in cold overdense magnetoplasma. (STAR)

9175 (N-73-16342) LINEAR AND NONLINEAR STABILITY CHARACTERISTICS OF WHISTLERS. Brinca, A. L. (Stanford Univ., Calif. Inst. for Plasma Research). Oct 1972. 176p. (NASA-CR-130349; SU-IPR-489). NTIS.

Linear and nonlinear propagating characteristics of right-hand polarized, slow electromagnetic, magnetoplasma waves (whistlers) are discussed in terms of stability and dispersion. An analysis of the stability of whistlers propagating at an angle to the static magnetic field is presented. A new mechanism is derived for the onset of stimulated emissions, and modulational instability for nonlinear whistlers are discussed. (STAR)

9176 (N-73-16344) STRUCTURE OF THE MAGNETOSPHERE AS DEDUCED FROM MAGNETOSPHERICALLY REFLECTED WHISTLERS. Edgar, B. C. (Stanford Univ., Calif. Radioscience Lab.). Mar 1972. Contract NAS5-2131. 195p. (NASA-CR-130356; SU-TR-3438-2; SU-SEL-71-70). NTIS.

Very low frequency (vlf) electromagnetic wave phenomenon called the magnetospherically reflected (MR) whistler was investigated. Vlf (0.3 to 12.5 kHz) data obtained from the Orbiting Geophysical Observatories 1 and 3 from October 1964 to December 1966 were used. MR whistlers are produced by the dispersive propagation of energy from atmospheric lightning through the magnetosphere to the satellite along ray paths which undergo one or more reflections due to the presence of ions. The gross features of MR whistler frequency-time spectrograms are explained in terms of propagation through a magnetosphere composed of thermal ions and electrons and having small density gradients across L-shells. Irregularities observed in MR spectra were interpreted in terms of propagation through field-aligned density structures. Trough and enhancement density structures were found to produce unique and easily recognizable signatures in MR spectra. Sharp cross-field density dropoff produces extra traces in MR spectrograms. (auth) (STAR)

9177 (N-73-16345) METHODS OF DETERMINING ELECTRON CONCENTRATIONS IN THE MAGNETOSPHERE FROM NOSE WHISTLERS. Park, C. G. (Stanford Univ., Calif. Radioscience Lab.). Jan 1972. 113p. (NASA-CR-130353; SU-TR-3454-1). NTIS.

Whistler propagation in the magnetosphere was studied in detail to find accurate and economical means of determining the path latitude and the electron concentration along the path from whistler parameters of nose frequency and travel time at the nose. Longitudinal propagation in field aligned whistler ducts of cold plasma was assumed, and the Earth's magnetic field was approximated by a centered dipole. The effects of whistler propagation in the Earth-ionosphere waveguide and through the conjugate ionospheres were treated as small perturbations. Several alternative methods are described so that the most economical method may be chosen depending on the desired accuracy and the availability of a computer or a calculator. (auth) (STAR)

9178 (N-73-16832) MAGNETOSPHERIC ELECTRON DENSITY MEASUREMENTS FROM UPPER HYBRID RESONANCE NOISE OBSERVED BY IMP-6. Shaw, R. R.; Gurnett, D. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Dec 1972. Contract NAS5-11074. 45p. (NASA-CR-130273). NTIS.

A band of natural radio noise between the local electron plasma frequency and the upper hybrid resonance frequency is observed by the IMP-6 satellite. The band exists over a large range of geocentric radial distances extending from inside the plasmapause boundary to greater than 10 earth radii in the outer magnetosphere. The center frequency of the noise band decreases with increasing radial distance, and changes abruptly at the plasmapause boundary. The broadband electric field strength of this noise is very small, seldom exceeding 10 microvolts/meter, and probably could not be detected without using long electric antennas of IMP-6. It is believed that this noise is produced by incoherent Cherenkov emission from super-thermal electrons. In some cases a second very narrow noise band was observed at a frequency slightly above the second harmonic of the electron gyrofrequency. (auth) (STAR)

9179 WAVE COUPLING AT A COLLISIONLESS PLASMA DISCONTINUITY. Kalra, G. L.; Rajaram, R.; Tandon, J. N. (Univ. of Delhi). Astrophys. Space Sci.; 17: No. 1, 87-116 (Jul 1972).

The coupling of magnetoacoustic waves at a plane interface that separates two semi-infinite collisionless fluids was studied. The fluids were characterized by different temperatures along and transverse to the ambient magnetic field. Continuum equations by Chew et al. (1956) were used and expressions for the reflection and transmission coefficients were derived. Extensive numerical computations were done to study the variation of the reflection coefficient, with the angle of incidence, for various temperature anisotropies of the media. Relevance of these investigations to the magnetosphere–solar wind boundary is discussed. (auth)

9180 FOTOKHIMIYA IONIZOVANNYKH I VOZBUZHDENNYKH CHASTITS V NIZHNEI IONOSFERE. (Photochemistry of Ionized and Excited Particles in the Lower Ionosphere). Danilov, A. D.; Vlasov, M. N. Leningrad; Gidrometeozdat (1973). 192p.

The modern problems of the upper atmosphere photochemistry, concentrated now mainly in the region of the lower ionosphere (50 to 200 km), are considered. The scheme of the processes, which governs the behavior of the ionized particles at different levels in the lower ionosphere, is presented and discussed. The detailed analysis of the ion composition variations is presented and the connection between the behavior of neutral and ionized particles is considered. The new direction of atmospheric photochemistry — the investigation of the processes with excited particles — is treated in detail. Both sides of the problem are considered — the

photochemistry of the excited atoms and molecules as itself and the contribution of these particles to such important questions of the ionospheric physics as ionization, electron detachment, nitric oxide formation. (auth)

9181 EXCITATION OF NATURAL OSCILLATIONS OF THE GEOMAGNETIC TAIL. Ershkovich, A. I.; Nusinov, A. A. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 759-763(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 877-881(1972).

The amplitudes of natural oscillations of the geomagnetic tail that appear during a change in solar-wind velocity are estimated. The tail is regarded as a plasma cylinder with a frozen-in magnetic field that is immersed in the interplanetary plasma. The boundary between the two media is free. The amplitudes obtained agree with the measured amplitudes. It is concluded that fluctuations of solar-wind parameters must give rise to periodic oscillations of the angle of aberration of the geomagnetic tail. (auth)

9182 STRUCTURE OF PULSATIONS OF THE ELECTROMAGNETIC FIELD OF THE EARTH AS A RANDOM FUNCTION OF TIME. Borets, V. V. (Sakhalin Combined Scientific Research Inst., Novo-Aleksandrovsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 764-766(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 882-885(1972).

A statistical model of pulsations as a random temporal process is constructed on the basis of a comparison of the quantitative characteristics of pulsations of the electromagnetic field of the earth T = 10 to 120 sec with their morphology. Pulsations recorded on quiet days belong to slow nonstationary processes and those recorded on disturbed days, to rapid nonstationary processes. (auth)

9183 RELATIONSHIP BETWEEN THE PARAMETERS OF GEOMAGNETIC Pi2 PULSATIONS AND PROCESSES IN THE AURORAL ZONE. Koshelevskii, V. K.; Raspopov, O. M.; Starkov, G. V. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 767-771(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 886-891(1972).

The relationship between the position and orientation of auroral forms and the parameters of type Pi2 pulsations was investigated. It is demonstrated that Pi2 are always accompanied by rayed forms. The Pi2 period depends on the position of an arc. The polarization axis of pulsations is approximately perpendicular to an auroral arc and its position changes synchronously with a change in the azimuth of the arc. (auth)

9184 PROPERTIES OF GEOMAGNETIC Pi2 PULSATION SPECTRA ALONG A MERIDIONAL PROFILE. Raspopov, O. M.; Troitskaya, V. A.; Baranskii, L. N.; Belen'kaya, B. N.; Koshelevskii, V. K.; Afans'eva, L. T.; Rox, J.; Fambitokoya, O. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 772-775(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 892-896(1972).

The spectral characteristics of geomagnetic Pi2 pulsations recorded simultaneously at the Soviet observatory network and at the equatorial Bangui Observatory were investigated. The variation of the spectral profile was obtained. High-frequency spectral components predominate at low latitudes, especially at equatorial stations. At latitudes of 50 to 60°, an additional maximum appears in the distribution of Pi2 amplitudes with distance from the equator toward auroral latitudes. (auth)

9185 RESONANCE ACCELERATION OF LOW-ENERGY PROTONS IN THE RADIATION BELTS OF THE EARTH. Vernov, S. N.; Panasyuk, M. I.; Sosnovets, E. N.; Tverskaya, L. V.; Khorosheva, O. V. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 683-686(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 785-789(1972).

The results of measurements of protons with E > 100 keV on Molniya 1 were used to investigate the intensity variations and spectrum of protons in radiation belts during the storm of July 25, 1970. Nonstationary maxima were observed to appear in differential proton spectra at L ≈ 2.5. The effects observed were compared with the data of the global magnetic station network. The results are interpreted in the framework of the theory of particle acceleration by electric fields associated with polar disturbances. (auth)

9186 ELECTRON ACCELERATION IN THE OUTER RADIATION BELT. Vernov, S. N.; Emel'yanenko, S. N.; Kuznetsov, S. N.; Stolpovskii, V. G. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 687-692(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 790-796(1972).

The rapid increase in the intensity of electrons with E > 40 keV, > 150 keV, and > 400 keV in the outer radiation belt during weak and moderate magnetic disturbances was analyzed on the basis of Elektron satellite data. The electron flux was observed to increase both during individual magnetic bays and during a series of bays. In the first case the electron fluxes increased both at the center of the belt and near its boundaries. During a series of magnetic bays, those electrons were most effectively accelerated whose period of drift around the Earth was equal to the repetition frequency of bays, indicating resonance-type acceleration. Acceleration of electrons near the outer-belt boundaries is achieved by a sharp decrease of the magnetic field at a distance of ~1 R_E in the tail of the magnetosphere on the night side, observed simultaneously with bays in the auroral zone; this corresponds to a collapse of geomagnetic lines of force. (auth)

9187 VARIATIONS IN THE INTENSITY OF THE EQUATORIAL JET CURRENT. Yaremenko, L. N. (Geophysics Inst., Kiev). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 810-812(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 933-935(1972).

In the regions of the equatorial jet current, the diurnal variations of H may change abruptly from one day to the next (from 80–100 to 200–250 γ). These changes are superimposed on the seasonal variations and the 11-year pattern. Data of seven South American observatories located at the magnetic equator were used to determine the amplitudes of the quiet diurnal variation for 1958. Graphs of the diurnal variations were plotted for each day, and the amplitudes were determined in the excess over the graphically averaged mean nightly value. (WDM)

9188 GEOMAGNETIC ABSORPTION EFFECT. Givishvili, G. V.; Fligel, M. D. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 812-814(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 936-937(1972).

To study the latitudinal variation of absorption, the apparatus described in Givishvili, et al. (1972) was installed on the R/V Akademik Kurchatov. The measurements were conducted for three months, from December 1970, between φ = 30°S and φ = 40°N (Φ = +48 to 21°) in the western hemisphere. The sounding was carried out continuously in the daytime at two frequencies whose choice was determined, on the one hand, by the critical frequency f_0E, and on the other hand, by the minimum reflection frequency f_{min}. (WDM)

9189 SIMULTANEITY OF THE APPEARANCE OF GEOMAGNETIC AND AURORAL PULSATIONS. Kazak, B. N.; Roldugin, V. K.; Chernous, S. A. (Polar Inst. of Geophysics, Apatity, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 817-819(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 941-943(1972).

The close relationship of irregular Pi1 and Pi2 pulsations of the geomagnetic field to auroral phenomena is well known. It has been noted that the appearance of pulsating auroras at an observation point is accompanied by geomagnetic pulsations, and that there frequently is a detailed correspondence of the two phenomena. However, some studies indicate cases of geomagnetic pulsations without pulsating auroras and vice-versa. An attempt is made to find out whether Pi1 and Pi2 pulsations are observed without pulsating auroras. (WDM)

9190 EFFECT ON MAGNETIC FIELD INHOMOGENEITY ON OSCILLATIONS OF THE PLASMA SHEET OF THE MAGNETOSPHERIC TAIL. Ershkovich, A. I.; Kuz'min, V. V. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 821-823(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 945-946(1972).

The oscillations of a plasma sheet with converging lines of force are examined. The plasma is considered to be inhomogeneous, ideally conducting and incompressible, and the magnetic field $B = (0, B_y, B_z)$, homogeneous in each of the half spaces $z > 0$ and $z < 0$, so that the plane $z = 0$, which imitates the neutral sheet, constitutes a rotational discontinuity. (WDM)

9191 DEPENDENCE OF THE POSITION OF THE MAGNETOPAUSE ON THE ORIENTATION OF THE INTERPLANETARY MAGNETIC FIELD. Kovner, M. S. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 823-825(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 947-949(1972).

Aubry et al., (1970), gave the results of an experiment on the OGO 5 satellite designed to determine the motion of the magnetospheric boundary. It was noted that in the course of about 2 hours, the magnetopause shifted inward on the day side to a distance of over 2 R_E. In the transition region, a regular magnetic field of southern direction with an intensity H ≈ 20 γ was observed. According to the data of Explorer 35, during that time, the field in the solar wind was also of southern direction, H ≈ 5 γ. The proton density and the temperature in the wind were $n \approx 3$ cm^{-3}, and $T \approx 9 \times 10^4$°K. Some hydrodynamic aspects of this motion of the boundary are discussed. (WDM)

9192 POSSIBILITY OF EXPERIMENTAL SEPARATION OF THE VARIABLE GEOMAGNETIC FIELD INTO A POLOIDAL AND A TOROIDAL PART. Berdichevskii, M. N.; Faynberg, E. B. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 826-830(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 950-953(1972).

The discussion concerning the role of the toroidal part of a variable geomagnetic field is continuing in the literature. Many of the arguments used have been obtained from general physical considerations of the field structure or from idealized theoretical models. For this reason, the best solution of the problem would be an experimental separation of the field into a poloidal and a toroidal part and an analysis of the relationships between them. Ways of achieving such separation are considered. (WDM)

9193 VARIATIONS OF THE INTERPLANETARY MAGNETIC FIELD AND THE SUBSTORM OF JUNE 17–18, 1965. Fel'dshteyn, Ya. I.; Sumaruk, P. V.; Shevnina, N. F. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 5, 838-839(1972).

Translated from Geomagn. Aeron.; 12: No. 5, 962-963(1972).

The appearance of substorms is known to correlate closely with the southern component of the interplanetary magnetic field. The cross correlation of the three components of the interplanetary magnetic field and of the AE index of magnetic activity during the period 20 to 06 UT on June 17–18, 1965 is examined. (WDM)

9194 THEORY OF MHD WEAKLY TURBULENT PLASMAS AND APPLICATIONS TO THE DIFFUSION OF PROTONS BY ALFVEN WAVES IN THE EARTH'S OUTER RADIATION BELTS. D'Amore, O. A. Boston; Boston Coll. (1972). 273p. University Microfilms Order No. 73-11,367.

Thesis (Ph. D.).

MHD plasma turbulence can be created in the equatorial region of the proton ring current by velocity space anisotropies in the particle distribution function. A review is presented of the morphology of the magnetospheric domains that relate to the thesis. The resonant turbulence of MHD plasmons is studied assuming the plasma consists of a cold uniform background and a high energy tail, embedded in uniform magnetic field. A review of the linear analysis is given. The diffusion of particles in the fluctuating plasma fields is examined by the standard methods. The formal structure of the method used is made more transparent by means of the generalization, to the MHD turbulence, of the diagram techniques of perturbation analysis of the Vlasov model. An integral recursion formula is derived; the perturbation of order n is generated by application of a plasma field input, the interaction operator, and the gyroresonance propagator to the perturbation of order (n-1). The diffusion equation of the quasilinear theory is applied to the diffusion of protons by Alfven waves. The two dimensional operators are transformed to one-dimensional ones and the steady state diffusion equation is solved. The time dependent problem and a mathematical model of the magnetic storm are analyzed. Speculations on the mechanism for the transport and acceleration of plasma sheet particles into the outer belts are considered. With the causes of the magnetic storms maintained at a constant level anomalous resistivity effects can give repeated substorms. (TSS)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 8878.

9195 (JINR-P14-7060) PERSPECTIVES OF PRACTICAL APPLICATION OF HEAVY ION BEAMS. Flerov, G. N.; Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Heavy ion physics is not only of unique importance for studying the fundamental problems of synthesis and structure of atomic nucleus, but is also extremely perspective in respect of its practical application in different fields of science and engineering. A series of such cases is considered. From the point of view of practical use the heavy ion beams are now in the same state as the techniques of light beams–lasers–were 10 to 15 years ago. (auth)

9196 POSSIBILITY OF USING A SOURCE OF THE BERNAS–NIER TYPE FOR NEGATIVE ION PRODUCTION. Denimal, J.; Ricaud, C. (Univ., Strasbourg). Nucl. Instrum. Methods; 109: No. 2, 409(1973).

Several negative ion beams have been obtained from a source of the Bernas–Nier type. (auth)

9197 MODULATION AND DEMODULATION OF PARTICLE BEAMS AT OPTICAL FREQUENCIES. Bergmann, E. E. (Lehigh Univ., Bethlehem, PA). Nuovo Cim.; 14B: No. 2, 243-259(11 Apr 1973).

A convenient formulation is presented for the discussion of experiments that are designed to modulate particle beams, such as an electron beam, and to demodulate this beam at optical frequencies. Such experiments have recently received considerable interest, and controversy, since the initial paper by Schwarz and Hora in 1969 which reported to have achieved such effects with light at 4880 Å. The formalism is fully relativistic and yields conclusions that both differ from and are more general than other attempts at relativistic formulations. The formulation utilizes the concept of a density matrix to describe the particle beam, and so one may determine the effects of poor beam collimation and of nonmonoenergetic distributions without restoring to the artifice of assuming some particular wave packet. The formalism displays the beneficial effects of collimation and energy selection and, in particular, the optimum design of a "polychromator" with regard to both energy and transverse-momentum selection. The formalism for the demodulation is used to calculate directly the radiation intensity rather than the mean amplitude of the modes of the radiation field. Thus one obtains expressions for the incoherent background that is also radiated during the demodulation process and may lead experimentally to poor signal-to-noise ratios. It is shown that this background is slightly different for boson and for fermion beams. It is found, in a model-independent way, that the maximum possible signal-to-noise ratio is much poorer than that indicated by Schwarz and Hora. The recent suggestion by Schmieder of detection of modulation by the presence of a second modulator is also considered. Additional complications relating to this type of experiment are found. (auth)

9198 SPIN POLARIZED ELECTRON BEAMS. Jost, K. (Univ., Muenster, Ger.). pp 37-64 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

Methods for producing spin polarized electron beams, figures of merit of a source of polarized electrons and detection of electron polarization, and what can be learned by experiments involving polarized electrons are considered. (auth)

9199 ION BEAM SOURCE FOR LOW ENERGY ION-NEUTRAL CROSSED BEAM STUDY. Mochizuki, T.; Arikawa, T. (Tokyo Univ.). Jap. J. Appl. Phys.; 12: No. 1, 1–6(Jan 1973).

An ion source for studies of ion-neutral scattering experiments is described. The ion source provides a mass selected ion beam of energies from several tens of eV to 1 eV or less, and delivers ion currents of 10^{-9} A at a high energy and 10^{-12} A at a low energy. The ion source consists mainly of an ionizer of electron impact, an rf quadrupole mass filter and a deceleration lens system. Transport lenses in front of and behind the rf quadrupole mass filter serve to maximize the transmission current to the subsequent deceleration lens. Beam properties together with optimum operating conditions are presented. Preliminary experimental results of elastic scattering are also presented. (auth)

9200 BEAM INTENSITY AT THE EXIT OF AN ATOMIC-BEAM TUBE. Kurakin, V. K. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 11, 1682-1684(Nov 1972).

Translated from Izmer. Tekh.; 15: No. 11, 55-56(Nov 1972).

A general expression is given for the beam intensity at the output from an atomic-beam tube. (WHK)

9201 METHOD AND DEVICE FOR THE PRODUCTION OF A BEAM OF IONIZED GAS. (to Wenzel, Helmut). German Patent 1,914,780. 1 Oct 1970. Filed date 22 Mar 1969. 15p. (In German).

A device is described for the production of a beam of ionized gas. The gas beam was produced, maintained, and at least partially ionized by charge carriers accelerated in an electrical field. It was aligned with a mechanical guide. The gas beam before and after the mechanical guide was exposed to the charge-carrier bombardment. The ion generator consists of a tube lying in the current direction of the gas beam and it affects the mechanical guide. It is at least partially in the electrical field and is open at both ends. The ion generator aligns the electrical field in the direction of the beam. It has a charge-carrier source which is arranged coaxial to or in the axis of the tube. The tube is displaced in the axial direction with respect to the charge-carrier source. (JSR)

9202 ANALYSIS OF HIGH-CHARGE STATE OUTPUT FROM A PENNING ION SOURCE. Darling, R. L.; Davis, R. H. (Department of Physics, The Florida State University, Tallahassee, Florida 32306). Rev. Sci. Instrum. 44: No. 4, 375-379 (Apr 1973).

Charge state yield data for the production of Ar ion beams from a Penning ion source have been previously analyzed by Fuchs. These data have been reanalyzed in calculations which take into account the Auger process at any level of ionization, electron recombination, and charge state dependent and independent losses. For a wide range of simple two-energy electron distributions, and for a discrete approximation to a distribution of thermalized electrons plus a Gaussian distribution of primary electrons, fits can be obtained which are as much as two orders of magnitude better for Ar^{9+} and even more improved for 10^{+}. The fitting parameters all lie near $\alpha \approx 10^{-8}$ for the recombination rate coefficient and $\tau \approx 1\mu$sec for ion lifetime for an electron density of 3×10^{14}/cm^3 The contribution to the rate of change of charge state population q_i due to electron recombination is assumed to be $(\rho_e\ q_i\ i^2\ \alpha)$, where ρ_e is the electron density. The Auger effect is included as a 2-electron process for most of the calculations. The estimated cross sections for Auger effects are derived similarly to those used in a feasibility study of electron beam sources of very heavy, highly ionized beams. (auth)

Atomic and Molecular Properties

Refer also to abstracts 8743, 9268, 9306, 9898, and 9919.

9203 LOOSE CONNECTION BETWEEN ELECTRON CONFIGURATION AND THE CHEMICAL BEHAVIOR OF THE HEAVY ELEMENTS (TRANSURANICS). Joergensen, C. K. (Univ., Geneva). Angew. Chem. Int. Ed. Engl.; 12: No. 1, 12-19(Jan 1973).

There is no straightforward relation between the ground electron configuration of the neutral atom and the chemistry of a given element. In particular, the choice of oxidation state depends on the comparison between consecutive ionization energies of the gaseous ions and the hydration energy or Madelung energy, which by preference stabilizes increased oxidation numbers. Special ligands, such as oxide, may introduce unexpectedly high oxidation numbers. The baricenters of electron configurations are discussed with vanadium and thorium as specific examples. The chemistry of the elements with Z = 101, 102, 103, 104, 105, and 112 (of which some thousand atoms have been reported) and the (yet unknown) elements with Z = 108, 109, 114, 126, 164, and 184 is discussed. (auth)

9204 FREE-ELECTRON GAS EXCHANGE CORRELATION ON THE CALCULATED RESULTS FOR DIAMAGNETIC SUSCEPTIBILITY AND ORBITAL MOMENTUM OF INERT-GAS ATOMS. Siqueira, M. L. (Univ. Federal de Minas Gerais, Belo Horizonte, Brazil); Leite, J. R. Nuovo Cim.; 14B: No. 2, 284-292(11 Apr 1973).

The results are presented of some calculations of diamagnetic susceptibility χ and orbital momentum $\langle r^n \rangle$ of the rare-gas atoms. For these calculations the nonrelativistic self-consistent numerical solutions of the Hartree–Fock equations are obtained utilizing

many approximations for the exchange correlation energy. These approximations are compared with the true Hartree–Fock exchange and with experiment. The calculations show that, using a self-consistent potential with tail correction, proportional to r^{-1} for large r, the Slater exchange gives results for χ most compatible with the experimental values. On the other hand, the Liberman approximation for the exchange energy gives results for χ quite similar to those obtained with Hartree–Fock exchange. The approximation based on the mass operator of the many-body theory, which includes the correlation effects among the electrons and retains the electron velocity dependence of the exchange, makes the calculated values diverge from the experimental results. (auth)

9205 VARIATIONAL SOLUTION OF THE LINEARIZED BOLTZMANN EQUATION WITH APPLICATIONS TO HELIUM. Revercomb, H. E. Madison, WI; Univ. of Wisconsin (1972). 133p. University Microfilms Order No. 72-31,700.

Thesis (Ph. D.).

The Boltzmann equation (BE), linearized by assuming the one particle distribution function to be nearly a local Maxwellian distribution, is solved by variational methods which bound transport coefficients (thermal conductivity and viscosity are treated) from above and from below. The methods are applied to the quantum hard sphere gas and to ^{3}He and ^{4}He modeled by the Lennard–Jones potential and by two semi-empirical potentials. The lower bound for the transport coefficients, which is the Chapman Enskog solution to the linearized BE, is calculated using a linear trial function with eight variational parameters. The trial function solution itself is a sum of generalized Laguerre polynomials that closely approximates the one particle distribution function for small velocities. Distribution functions, which were also calculated for large velocities by an independent method, are plotted for each potential. The variational upper bound requires that the lowest nonzero eigenvalue of the binary collision operator for the linearized BE be finitely different from zero. The upper bound results for the hard sphere (He) transport coefficients lie within 0.1 (0.6)% of the calculated lower bounds over the temperature range 1.8 to 180°K (1 to 20°K) (the temperature range for the hard sphere potential assumes He parameters). Neither bound differs by more than 2.5% from transport coefficients calculated with the second Kihara approximation, and the difference except at the lowest temperatures is much less than 2.5%. Upper bounds to the lowest three eigenvalues of an 8 × 8 approximation to the binary collision operator are also given for each potential. For potentials whose differential cross sections are bounded (this does not include the hard potentials considered here because of the diffraction peaks in their differential cross section), it is shown that the continuous spectrum of the binary collision operator is determined by the collision frequency. (Diss. Abstr. Int., B)

9206 COULOMB HOLES AND EXPECTATION VALUES. I. EXPLICITLY CORRELATED WAVEFUNCTIONS. Banyard, K. E.; Seddon, G. J. (Department of Physics, University of Leicester, Leicester, England). J. Chem. Phys. 58: No. 3, 1132-1142 (1 Feb 1973).

We have examined, in depth, several wavefunctions for the two electron systems H^-, He, Li^+, and Be^{++} already reported in the literature: three noncorrelated wavefunctions and ten explicitly correlated wavefunctions. For each wavefunction we calculated the two-particle distribution function $f(r_{12})$ and from it obtained the Coulomb hole. The expectation values $\langle r^n \rangle$, Δr, ρ (o), $\langle \delta^3(r_1) \rangle$, $\langle \delta^3(r_{12}) \rangle$, $\langle r_{12}^n \rangle$, Δr_{12}, $\langle \cos\gamma_{12} \rangle$, $\langle r_1 . r_2 \rangle$, $\langle r_1 (r_1 . r_2) \rangle$, and α, the electric dipole polarizability, have also been evaluated. By comparing the results for different wavefunction some insight was obtained into the roles played by different types of correlation factor. (auth)

9207 CLASSIFICATION OF CONFIGURATIONS AND THE DETERMINATION OF INTERACTING AND NONINTERACTING SPACES IN CONFIGURATION INTERACTION. McLean, A. D.; Liu, B. (IBM Research Laboratory, San Jose, California 95114). J. Chem. Phys. 58: No. 3, 1066-1078 (1 Feb 1973).

The n–particle space of a configuration interaction (CI) calculation, spanned by configuration state functions (CSF's), is partitioned into subspaces defined, relative to a set of zeroth–order CSF's, by the type of orbital excitation and by the lowest order of the Rayleigh–Schrödinger perturbative correction contributed by the subspace. A method is given for determining CSF's spanning the ith–order subspace which contains those and only those functions that have a nonzero interaction through the Hamiltonian with some member of the (i–1)th–order subspace. These subspaces are anticipated to be of considerable use in structuring and interpreting configuration interaction wavefunctions. (auth)

9208 ELECTRONIC RECOMBINATION OF HE_2^+. Boulmer, J.; Davy, P.; Delpech, J.–F.; Gauthier, J.–C. (Groupe d'Electronique dans les Gaz, Institut d'Electronique Fondamentale, 220 Faculté des Sciences, 91405 Orsay, France). Phys. Rev. Lett. 30: No. 6, 199-202 (5 Feb 1973).

A new afterglow analysis technique has been developed involving no assumption about the functional dependence (or lack of dependence) of the recombination rate coefficient on experimental parameters such as electron density or temperature. Explicit account is taken of the measured electron source term due to ionization during the afterglow. Preliminary results obtained at 295°K neutral temperature, at pressures from 20 to 30 Torr, at electron temperatures from 295 to 500°K, and over a limited range of electron densities near 10^{11} cm^{-3} are in satisfactory agreement with collisional radiative recombination theories. (auth)

9209 INFRARED ATOMIC WAVENUMBER LIBRARY. Outred, M. (Polytechnic, London). Infrared Phys.; 13: No. 2, 131–133(May 1973).

An infrared atomic vacuum wave number library, covering the range 10,000 to 2500 cm^{-1}, was developed. At the present time 12,827 wave numbers of 56 elements (which includes the relevant elements Ce, Dy, Gd, He, La, Lu, Nd, Np, Pa, Pu, Sm, Tb, Tl, Tm, U and Yb) are stored and, as further information is published, the new data are added to the library. A wave number search program was developed to help in the identification of impurity lines which may appear in a recorded infrared atomic spectrum. (auth)

9210 VIBRATIONAL RELAXATION IN HYDROGEN–RARE-GASES MIXTURES. Audibert, M. M.; Joffrin, C.; Ducuing, J. (Paris Univ., Orsay, France). Chem. Phys. Lett.; 19: No. 1, 26-28(1 Mar 1973).

Vibrational relaxation in H_2–rare-gases mixtures was studied, using the Raman excitation of H_2. The measurements performed on binary and ternary H_2–He–Ar mixtures yielded the following rates at room temperature: $p\tau_{H_2-He} = 2280$ μsec atm, $p\tau_{H_2-Ar} = 7150$ μsec atm. The H_2–He value obtained is more than one order of magnitude smaller than that predicted by Shin's theory. (auth)

9211 STERNHEIMER SHIELDING–ANTISHIELDING; RARE–EARTH IONS. Gupta, R. P.; Sen, S. K. (Department of Physics, University of Manitoba, Winnipeg, Canada.). Phys. Rev. A 7: No. 3, 850-858 (Mar 1973).

Sternheimer shielding–antishielding parameters pertinent to the quadrupole perturbations outside an ion (λ), as well as within the ion owing to an unfilled 4f shell (R), have been calculated for rare–earth ions La^{3+}, Ce^{3+}, Pr^{3+}, Nd^{3+}, Pm^{3+}, Sm^{3+}, Eu^{3+}, Gd^{3+}, Tb^{3+}, Dy^{3+}, Ho^{3+}, Er^{3+}, Tm^{3+}, Yb^{3+}, Lu^{3+}, Sm^{2+}, and Eu^{2+}. Hartree–Fock–Slater–type ionic wave functions have been used. The value of λ_0 varies smoothly from –65.82 for La^{3+} to –58.49 for Yb^{3+}, whereas that of R_0 (without exchange) varies from 0.081 for Ce^{3+} to 0.128 for Yb^{3+}. The calculation of Sternheimer parameters for Sm^{2+} and Eu^{2+} with λ_0=–73.28 and R_0=0.124 for Sm^{2+} shows that their dependence on the charge of the ions is appreciable. Sternheimer parameters are reported also for the core–electron sites. (auth)

9212 CALCULATIONS OF HARTREE–FOCK POLARIZABILITIES FOR SOME SIMPLE ATOMS AND MOLECULES, AND THEIR PRACTICALITY. Gutschick, Vincent P.; McKoy, Vincent (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasasena, California 91109). J. Chem. Phys. 58: No. 6, 2397-2401 (15 Mar 1973).

Hartree–Fock electric polarizabilities have been calculated for H_2, He, Li, Be, LiH, and N_2. Perturbation theory with all the coupling terms was employed variationally for the first five, using a variety of basis sets for each. Each basis for the perturbation calculations was composed of a zero–order set, plus a first–order set (appropriate to the direction of polarization, for the molecules). The two sets are disjoint to ensure identical zero–order functions for the two molecular polarizability components and, hence, reliable anisotropy values. Nonorthogoanl theory as formulated by Das and Duff assuming exact zero–order orbitals, was used for LiH. For practical reasons, the nitrogen molcule was treated by the fully self–consistent approach which does not distinguish orders of perturbation. The results for all six species are in very good agreement with experiment, reflecting both a reliable choice of polarization functions and, more significantly, the basic accuracy of the Hartree–Fock method for the static charge distributions, both unperturbed and perturbed by an electric field. (auth)

9213 LINE SHAPE AND INTENSITY CONSIDERATIONS IN MICROWAVE OPTICAL MAGNETIC RESONANCE INDUCED BY ELECTRONS AND RELATED EXPERIMENTS. Miller, Terry A. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 58: No. 6, 2358-2365 (15 Mar 1973).

A density matrix approach to the phenomena of molecular level crossing, level anticrossing, and double resonance experiments is formulated. A general equation for the time evolution of the density matrix has been obtained, which can be used to describe the above behavior in a multilevel system. The equations appropriate to a

MOMRIE (Microwave Optical Magnetic Resonance Induced by Electrons) experiment are solved explicitly in the two-level approximation. The applicability of this approximation to the MOMRIE experiment on the H_2 molecule is quantitatively examined, analytically and by computer simulation. Predictions of the theory are compared with observed lineshapes, relative and absolute intensities, and linewidths obtained from MOMRIE experiments. (auth)

9214 FINE STRUCTURE AND HYPERFINE STRUCTURE OF ORTHO-H_2D(3P)$^3\Pi_u$(V=0-3) VIA MICROWAVE OPTICAL MAGNETIC RESONANCE INDUCED BY ELECTRONS. Miller, Terry A.; Freund, Robert S. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Chem. Phys. 58: No. 6, 2345-2357 (15 Mar 1973).

Microwave Optical Magnetic Resonance Induced by Electrons (MOMRIE) has been observed for vibrational levels v=0-3 of ortho-H_2 in the d(3p)$^3\Pi_u$ state with rotational quantum number N=1. The theory used to analyze the spectrum is essentially the same as that which has previously been applied to the metastable c(2p)$^3\Pi_u$ state, but several additions are also given. The theory, as previously, has been formulated in terms of a representation in which the angular momenta are all coupled. However, a semiquantitative formulation in terms a lifetime of 32 ± 5 nsec for the state. of an entirely decoupled representation (which is more nearly appropriate for the MOMRIE experiment) is also presented. Least squares fits of the observed MOMRIE lines to the coupled theory provide accurate determinations of the fine and hyperfine structure parameters. Parameters determined in this way include those commonly referred to as the spin-orbit coupling constant, the spin-spin coupling constant, the dipolar hyperfine coupling constant, the orbital angular momentum hyperfine parameter, and the orbital angular momentum g factor. Vibrational variation of the fine structure parameters is easily measurable while that of the hyperfine structure parameters is comparable to the experimental error. The linewidth of the MOMRIE transitions yields (auth)

9215 SIMPLE TEST OF THE UTILITY OF MODIFIED HARTREE-FOCK ORBITALS: THE He ATOM. Palting, P. (American Univ., Washington, DC); Sanders, W. A. Int. J. Quant. Chem.; 7: No. 2, 301-307(Mar 1973).

A method proposed recently for the generation of modified Hartree-Fock virtual orbitals was tested by performing a simple configuration-interaction calculation for the ground state of the He atom. A very compact truncated basis set was constructed by using an a priori criterion based on the probability density within the region of the occupied orbital. The best results were obtained by making the virtual orbital energies more positive. (auth)

9216 METHOD FOR OPTIMIZATION OF THE SCF ENERGY AS A FUNCTION OF SLATER EXPONENTS. Bouscasse, L.; Phan Tan-Luu, R.; Vincent, E. J.; Metzger, J. (Univ. Provence, Marseille). Int. J. Quant. Chem.; 7: No. 2, 357-364(Mar 1973). (In French).

A method to optimize simultaneously Slater orbital exponents is described. The procedure is based on Newton's method and requires the derivatives of the energy as a function of the exponents. The calculation of these derivatives is described explicitly. The method has been applied to the hydrogen molecule. (auth)

9217 TUNNELING PHENOMENA IN THREE-DIMENSIONAL DOUBLE-WELL POTENTIALS. Carbonell, R. G.; Kostin, M. D. (Princeton Univ., NJ). Int. J. Quant. Chem.; 7: No. 2, 319-332 (Mar 1973).

The tunneling of a hydrogen atom through the barrier of a three-dimensional double-well potential is considered. From the time-dependent Schrödinger equation, expressions are derived for the ensemble-averaged probability density and for the probability that the hydrogen atom is in the reactant region, in the barrier region, or in the product region. It is found that when thermal vibrations are not taken into account, the ensemble-averaged probability density may oscillate with time about its equilibrium value. When thermal vibrations are included, the oscillations become damped and the probability density approaches equilibrium. The tunneling rate is found to decrease considerably for increasing barrier thickness and barrier height. (auth)

9218 EXPERIMENTAL INVESTIGATION OF THE TEMPERATURE DEPENDENCE OF THE SCOTT THERMOMAGNETIC TORQUE IN n-H_2 AND n-D_2. Wang, F. C. College Station, TX; Texas A and M Univ. (1972). 39p. University Microfilms Order No. 73-12,297.

Thesis (Ph.D.).

An investigation of the temperature dependence of the thermomagnetic torque was carried out in normal hydrogen and normal deuterium. Measurements were made with a very sensitive torsion pendulum over a range of temperatures from 200 to 386°K, a pressure range of 0.06 to 1.50 torr, and a magnetic field range of a few oersteds to 250 Oe. At room temperature, the torque was found to exhibit peaks at two magnetic field values in n-D_2. In both gases investigated, the optimum value of the torque-times-pressure was found to increase with temperature for temperatures from 200 to about 300°K, and then to remain constant (as in n-D_2) or to decrease slightly (as in n-H_2) when the temperature was further increased to 386°K. (Diss. Abstr. Int., B)

9219 HIGH RESOLUTION SPECTROSCOPY WITH LASERS. Demtroeder, W. (Univ., Kaiserlautern, Ger.). Phys. Rep.; 7C: No. 5, 223-277(Apr 1973).

A review is given about recent applications of lasers in high resolution spectroscopy including methods with high spectral- or high time-resolution. Following a short survey about the characteristic features of lasers important for spectroscopic research, some examples are discussed where lasers were used in molecular emission- and absorption-spectroscopy. New techniques are outlined which overcome the Doppler-limitation in spectral resolution as for instance saturation-spectroscopy, level crossing or double-resonance-techniques. Some experiments are mentioned where the capability of lasers in producing ultrashort optical pulses are used for subnanosecond spectroscopy. (auth)

9220 RELATIVISTIC CORRECTION TO THE 1S-2S TRANSITION IN HYDROGEN ATOMS IN INTENSE FIELDS. Haque, S. N. (Centre of Advanced Study in Physics, University of Delhi, Delhi-7, India). Phys. Rev. A 7: No. 3, 907-910 (Mar 1973).

Using a recent method due to Reiss, the relativistic effect to multiphoton absorption in hydrogenlike atoms in the presence of intense electromagnetic fields of long wavelength is calculated. For an intensity parameter less than unity the corrections are found to be small for any number of photons absorbed. However if the intensity parameter exceeds unity by a considerable amount, corrections become significant. (auth)

9221 EFFECTIVE-FIELD CALCULATIONS OF POLARIZABILITIES AND SHIELDING FACTORS FOR HE, NE, A, AND KR ISOELECTRONIC SERIES. Litt, Clotilde (Department of Theoretical Physics, University of Liège, Belgium). Phys. Rev. A 7: No. 3, 911-921 (Mar 1973).

Electronic dipole and quadrupole polarizabilities and the Sternheimer shielding or antishielding factors are calculated for several closed-shell atomic systems. The calculations are carried out by an effective-field method using the perturbed orbitals, given by the uncoupled Hartree-Fock method, as trial functions. The external field is replaced either by a mean effective field taking into account the mean coupling between the deformations of the various orbitals, or by a set of effective fields, each of them being relative to a particular perturbed orbital. Numerical results obtained for the He, Ne, A, and Kr isoelectronic series show a much better agreement with the corresponding coupled values than the initial uncoupled results. (auth)

9222 TIME-DEPENDENT STUDIES OF VACUUM-ULTRAVIOLET EMISSIONS FROM HELIUM. Bartell, D. M.; Hurst, G. S.; Wagner, E. B. (Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). Phys. Rev. A 7: No. 3, 1068-1078 (Mar 1973).

Proton excitation was employed to obtain new information on the vacuum-ultraviolet (vuv) emissions from helium gas. Time-dependent studies of the 584-Å resonance line and the vuv continuum (600-950 Å) have been made as a function of pressure. The decay rate for 584-Å resonance photons shows a type of pressure dependence which indicates that the 2^1P atomic state is destroyed much more rapidly by collisions than by radiation to the 2^1S metastable state. Most of the vuv continuum decays with two time components (fast and slow). The number of ions and the population of the lowest-ten excited states resulting when an energetic (4-MeV) proton loses a fraction of its energy in helium, and when the secondary electrons completely degrade in energy, have been calculated. The theoretical studies indicate that about 30% of the energy lost by a single proton goes into atomic excitation, where about one-half of these excited states are 2^1P states. These new results are combined with previous information to propose an energy pathways model for helium. We suggest that the 2^1P state is primarily destroyed by collisions to the D and B molecular states which are then the source of the fast vuv radiation (640-950 Å) and the precursor of slow radiation, respectively. In our model the metastable B molecular state stores the energy which is utilized in producing additional ionization (Jesse effects) when impurities are added to helium, in contrast with previous interpretations which assumed that the energy is stored in atomic metastable states. (auth)

9223 LEVEL STRUCTURE OF DOUBLY IONIZED ERBIUM (ER III). Spector, Nissan (Observatoire de Paris, 92-Meudon, France). J. Opt. Soc. Am. 63: No. 3, 358-361 (Mar 1973).

The low levels of the four basic configurations of doubly ionized erbium $4f^{12}(^3H_6,5F_4)$, $4f^{11}(^4I_{15/2}){5d}$, $4f^{11}(^4I_{15/2,13/2}){6s}$, and $4f^{11}(^4I_{15/2,13/2}){6p}$ are reported. More than a hundred Er III lines are classified by 24 odd and 18 even levels. Values for the spin-orbit parameters obtained directly from the observed levels are $\zeta_{6p}=3743$ cm^{-1}, $\zeta_{5d}=1326$ cm^{-1}. (auth)

9224 ULTRAVIOLET SPECTRUM EMITTED FROM A LASER-PRODUCED URANIUM PLASMA. Williams, M. D. (NASA, Langley Research Center, Hampton, Virginia 23365). J. Opt. Soc. Am. 63: No. 3, 383-384 (Mar 1973).

Index Headings: Uranium; Spectra; Ultraviolet; Plasma; Source; Laser. (auth)

The region between 300 and 1500 Å was investigated. A Q-spoiled ruby laser was focused onto the flat surface of a ^{238}U surface that was 99.9% pure. Conditions in the nonfissioning laser plasma simulate expected gas-core reactor conditions. (CES)

9225 ELECTRONIC-RECOMBINATION COEFFICIENT OF $^3HE_2^+$ COMPARED TO $^4HE_2^+$. Johnson, A. Wayne; Gerardo, J. B. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. A 7: No. 4, 1339-1341 (Apr 1973).

The electronic-recombination coefficient of $^3He_2^+$ is shown to be $(1.23\times10^{-8}+5.04\times10^{-10}p)$ cm^3sec^{-1}, compared to that of $^4He_2^+$, which is $(1.15\times10^{-8}+3.86\times10^{-10}p)$ cm^3sec^{-1}, where p is the gas pressure in Torr. (auth)

9226 EXCITED STATE WAVEFUNCTIONS FOR HELIUM. Tweed, R. J. (Quenn's Univ., Belfast). J. Phys., B (London); 6: No. 5, 770-781(May 1973).

Using several angular momentum terms and a parametric expansion for the radial function, wave functions are obtained for certain excited S, P, D, and F states of helium, the virial theorem being satisfied exactly. (auth)

9227 COULOMB HOLE IN SOME EXCITED STATES OF HELIUM. Boyd, R. J.; Coulson, C. A. (Oxford Univ.). J. Phys., B (London); 6: No. 5, 782-793(May 1973).

The distribution function $f(r_{12})$ of the interelectronic distance r_{12} in the 2 ^3S and 2 ^1S states of helium is calculated for several different wave functions. Mean values of positive and negative integral powers of r_{12} are reported. The dependence of $f(r_{12})$ on the atomic number is shown to provide some additional physical insight into the excited states of helium. The Coulomb holes of the 2 ^3S and 2 ^1S states are calculated and found to be more complex than the Coulomb hole of the ground state. The effect of the Fermi hole in the triplet state is discussed. A new distribution function $g(r_{12},r_1)$ is introduced and is used to discuss the Coulomb hole in terms of the chosen position of electron 1, It is observed that when one electron is far from the nucleus the Coulomb hole is essentially centered on the nucleus, whereas at small distances from the nucleus the Coulomb hole follows the electron. (auth)

9228 APPLICATION OF THE MOMENTUM TRANSLATION METHOD TO MULTIPHOTON IONIZATION OF HYDROGEN BY INTENSE ELECTROMAGNETIC FIELDS. DeWitt, R. N. (Naval Research Lab., Washington, DC). J. Phys., B (London); 6: No. 5, 803-808(May 1973).

A nonperturbative theory, the momentum translation method, is applied to multiphoton ionization of hydrogen by an intense electromagnetic field. Using an approximation depending on a large number of photons absorbed, analytical results are presented for transitions from a 1S state to Coulomb states in the continuum. Results not only show the characteristic perturbation theory dependence of the intensity raised to the Nth power for an Nth order process, but give an explicit expression for the transition as a function of the number of photons absorbed, and the final electron angular momentum and energy. This type of functional dependence is very obscure in perturbation theory by its very nature. In particular, transitions to states with angular momenta 2, 4, and 6 dominate the $l = 0$ transition in the absorption of 12 photons with energy of 1.17 eV, while $l = 3, 5, 7$ transitions dominate the $l = 1$ transition when 13 photons are absorbed. Also for particular values of the field intensity and final angular momentum the transition matrix is larger for a larger number of photons absorbed. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 9706 and 9924.

9229 FIRST OBSERVATIONS OF POSITRONIUM IN CONDENSED MATTER (γ-ALUMINA). Judd, D. J. Baltimore; Johns Hopkins Univ. (1972). 102p. University Microfilms Order No. 73-12,147.

Thesis (Ph.D.).

The fine structure interval of positronium in the ground state, $\Delta\nu$, was measured for the first time in condensed matter (γ-Al_2O_3). This atom was most probably formed in its ground state by stopping positrons from the decay of sodium-22 in the oxide. Zeeman transitions between the $m = \pm1$ and $m = 0$ substates of orthopositronium were induced by a microwave magnetic field. The subsequent transitions were detected by a change in the two-photon annihilations. A value of $\Delta\nu$ in γ-Al_2O_3 was set at $\Delta\nu = (203.289 \pm 0.044)$ GHz. This value is 2.5 standard deviations below the current value for the free atom. Also the lifetime of positronium was studied in ZnO, γ-Al_2O_3 and MgO, each of two different mean grain sizes, by recording the time annihilation events of positrons from ^{22}Na. These studies were conducted in an effort to confirm early correlations drawn between surface area of pores, grain sizes and pore volumes of the oxides, with ultimate purpose to select one for the $\Delta\nu$ measurement. These data show reduction of intragrain gases by introduction of a vacuum increases positronium production by a factor of two in some cases. Equally, for the first time magnetic field quenching experiments combined with lifetime studies were made on the oxides. Analysis of this data confirms the theoretical work of Drisko of the angular dependence between the annihilation γ-rays of the $m = \pm1$ states and the quenching magnetic field. (Diss. Abstr. Int., B)

9230 OBSERVATION OF A POSITRONIUM ZEEMAN TRANSITION IN γ-AL_2O_3. Judd, D. J.; Lee, Y. K.; Madansky, L. (Physics Department, The Johns Hopkins University, Baltimore, Maryland 21218); Carlson, E. R.; Hughes, V. W.; (and others). Phys. Rev. Lett. 30: No. 6, 202-204 (5 Feb 1973).

The Zeeman transition between the $M=\pm1$ and $M=0$ states of orthopositronium in its ground state has been observed in a solid for the first time, when positrons were stopped in a γ-Al_2O_3 powder pellet, thus providing strong evidence that essentially free orthopositronium exists in γ-Al_2O_3. The value for the positronium fine-structure interval is $\Delta\nu$ (γ-Al_2O_3) $=203.308\pm0.024$ GHz (120 ppm). The difference $\Delta\nu$ (free Ps)–$\Delta\nu$ (γ-Al_2O_3) is $\overline{88}\pm25$ MHz. (auth)

9231 NUCLEAR EXCITATION BY THE BOUND MUON AND THE MUONIC HYPERFINE STRUCTURE. Konishi, T. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1569-1580 (Nov 1972).

For the even–even transition nuclei a theory of the nuclear quadrupole excitation by the bound muon is formulated using a realistic nuclear wave function on the basis of the anharmonic oscillator model. The hyperfine spectrum of the muonic x-ray is predicted for ^{192}Os, and the dependence of the nuclear parameters on the spectrum is also discussed. Then one can suggest that it is possible to discriminate the nuclear model and to find out some nuclear properties in comparison with more precise measurement of muonic x-rays. (auth)

Collision Phenomena

9232 (N–73-12763) FORMATION OF EXCITED ATOMS DURING CHARGE EXCHANGE BETWEEN HYDROGEN IONS AND ALKALI ATOMS. Nieman, R. A. (Pittsburgh Univ., PA. Space Research Coordination Center). 1971. 205p. (NASA-CR–129262). NTIS.

Thesis.

The charge exchange cross sections for protons and various alkali atoms are calculated using the classical approximation of Gryzinski. It is assumed that the hydrogen atoms resulting from charge exchange exist in all possible excited states. Charge transfer collisions between protons and potassium as well as protons and sodium atoms are studied. The energy range investigated is between 4 and 30 keV. The theoretical calculations of the capture cross section and the cross section for the creation of metastable 2S hydrogen are compared to experimental values. Good quantitative agreement is found for the capture cross section but only qualitative agreement for the metastable cross section. Analysis of the Lyman alpha window in molecular oxygen suggests that measured values of the metastable cross section may be in error. Thick alkali target data are also presented. This allows the determination of the total electron loss cross section. Finally, some work was done with H2(+). (STAR)

9233 (ORNL-TM–4239) THEORY OF SINGLE ELECTRON EXCITATION AND TRANSFER IN NEUTRAL ATOM–ATOM COLLISIONS. Vora, R. B.; Turner, J. E.; Compton, R. N. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 106p. Dep. NTIS $7.50.

Thesis. Submitted by R. B. Vora to Univ. of Tennessee, Knoxville.

A semiclassical approach is used to calculate excitation and charge-transfer cross sections in neutral atom–atom collisions. Use of single-electron wave functions in a time-dependent perturbation theory gives a set of coupled differential equations. A

transformation reduces these equations to a tractable form in a three-state approximation. The formalism is applied to alkali atom-oxygen collisions. The three states are taken to be the ground and the first excited ($^2P_{\frac{1}{2}}$) states of the alkali atom and the single stable state of the O^- ion. Charge-transfer and excitation cross sections are calculated initially in two-state approximations for energies between 10 eV and 10,000 eV. The resulting charge-transfer cross sections generally agree with available results based on Landau-Zener theory. The transition probability for transfer at high velocities is found to vary as $1/v^2$, as in the Born approximation, rather than $1/v$, as predicted from Landau–Zener theory. In the three-state approximation, calculations are performed to study the effects of the simultaneous existence of two final states on the charge-transfer and excitation cross sections. It is found that, in the energy range 10 eV to 10,000 eV, the charge transfer cross sections remain almost unaffected. The excitation cross sections are considerably altered by the presence of the ionic channel. In particular, at lower velocities they are considerably higher than in the two-state approximation. (auth)

9234 (SLA-73-465) CLASSICAL ATOMIC SCATTERING CROSS SECTIONS FOR θ_{Lab}= 90° BASED ON A SCREENED COULOMB POTENTIAL. Nelson, G. C. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 55p. Dep. NTIS $4.75.

Bingham has tabulated the classical atomic scattering parameters based on a screened Coulomb potential. These tables were interpolated to obtain the differential scattering cross sections at θ_{Lab}= 90° for incident ions of $^3He^+$, $^4He^+$, and $^{20}Ne^+$ as a function of energy (0.3 to 2.9 keV) and target atom. Tables of these values are presented along with graphs of σ vs Z for $^3He^+$ and $^{20}Ne^+$ at 1500 and 2500 eV incident energy. (auth)

9235 DEPENDENCE OF ARGON K-SHELL IONIZATION ON THE CHARGE OF BARE NUCLEI AT 1 TO 2 MEV/AMU. Macdonald, J. R.; Winters, L. M.; Brown, M. D.; Ellsworth, L. D.; Chiao, T.; (and others) (Physics Department and Nuclear Science Laboratory, Kansas State University, Manhattan, Kansas 66506). Phys. Rev. Lett. 30: No. 7, 251-254 (12 Feb 1973).

Argon K-shell ionization cross sections have been determined from x-ray yields measured in single collisions with beams of the bare nuclei C^{+6}, N^{+7}, O^{+8}, and F^{+9} at energies of 1.05, 1.50, and 1.88 MeV/amu. The data deviate by as much as a factor of 2.6 from the Z_1^2 dependence predicted for ionization cross sections. This deviation monotonically increases with Z_1 and increases somewhat with velocity. (auth)

9236 TEMPERATURE DEPENDENCE OF THE 3^1P EXCITATION TRANSFER CROSS SECTION OF HELIUM. Hunter, William W. Jr. (NASA, Langley Research Center, Hampton, Virginia, 23365); Leinhardt, T. E. J. Chem. Phys. 58: No. 3, 941-947 (1 Feb 1973).

Inelastic collisions between helium atoms in 3^1P and 1^1S states can result in radiationless transfers of excitation. Measurements were made to determine the cross section of the excitation transfer and its variations with the relative velocity of interacting atoms. The collision process was investigated in low density (10^{15}–10^{18} atoms/cm^3) helium gas at four different temperatures between 296°K and 22°K. A 30 KeV electron beam provided primary excitation of the 3^1P state. The cross sections were found to be $1.6(\pm0.3) \times 10^{-15}$ cm^2 at 296°K, $1.3(\pm0.8) \times 10^{-15}$ cm^2 at 214°K, $1.1(\pm0.2) \times 10^{-15}$ cm^2 at 82°K, and $1.7(\pm0.3) \times 10^{-15}$ cm^2 at 22°K. A comparison of the experimental results with the predictions of the Stueckelberg theory for imperfect resonance excitation transfer was made. Results indicate possible dipole-quadrupole and quadrupole-quadrupole interactions. (auth)

9237 AB INITIO CALCULATION OF THE HELIUM-HELIUM $X^1\Sigma^+_G$ POTENTIAL AT INTERMEDIATE AND LARGE SEPARATIONS. II. CHANGES IN INTRA ATOMIC CORRELATION ENERGY. Bertoncini, P. J.; Wahl, Arnold C. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). J. Chem. Phys. 58: No. 3, 1259-1261 (1 Feb 1973).

Results of investigations to determine the effect of the changes of intra-atomic correlation energy of He atoms on the calculated well depth of the interatomic potential are reported. (CES)

9238 PROHIBITED AUTODETACHMENT IN OD^- FORMED BY COLLISIONS OF O^- WITH D_2. Doverspike, L. D.; Champion, R. L.; Lam, S. K. (Department of Physics, College of William and Mary, Williamsburg, Virginia 23185). J. Chem. Phys. 58: No. 3, 1248-1250 (1 Feb 1973).

Preliminary results of the ion-molecule reaction $O^- + D_2 \rightarrow OD^- + D$ are reported. The experiments were performed with an ion-beam gas-target scattering apparatus. (CES)

9239 CLOSED-FORM GLAUBER CROSS SECTIONS IN P-H AND E^--H COLLISIONS I. Thomas, Brian K.; Gerjuoy, E. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). J. Math. Phys. (N.Y.) 14: No. 2, 213-218 (Feb 1973).

The Glauber predicted integrated (over scattering angle) cross section for the elastic scattering of charged particles by ground state atomic hydrogen is evaluated in closed form. The asymptotic form of the Glauber cross section for large incident particle momenta is obtained and compared with the exact first Born approximation result. The present analytic results, together with previous numerical results, indicate that (neglecting exchange) the Glauber integrated elastic scattering cross section is well represented, for both incident electrons and incident protons, by $\sigma_{elastic} = (7/3)v_i^{-2}\pi a_0^2$ at essentially all incident particle speeds v_i. (auth)

9240 MATHIEU FUNCTION SOLUTIONS TO THE RADIAL SCHRÖDINGER EQUATION FOR THE $-F^2/R^4$ INTERACTION. Holzwarth, N. A. W. (The Department of Physics and The James Franck Institute, The University of Chicago, Chicago, Illinois 60637). J. Math. Phys. (N.Y.) 14: No. 2, 191-204 (Feb 1973).

We describe the Mathieu function solutions to the radial Schrödinger equation for the $-f^2/r^4$ potential with reference to adiabatic elastic scattering of electrons from neutral atoms. By an appropriate choice of boundary conditions, the total scattering phase shift δ_l decomposes into two parts: $\delta_l = \pi_l + \rho_l$. The "polarizability phase shift" ρ_l depends solely on parameters of the interaction and is easily calculated. The "polarizability extracted phase shift" γ_l contains information of the core interaction. We suggest that such a parametrization of this scattering provlem is convenient for data analysis or for potential scattering calculations. We find that the Mathieu function solutuions are characterized by a "polarizability range" $r_l = \sqrt{f/k}$. For $r > r_l$, the functions resemble spherical waves with phase shift ρ_l with respect to the free particle wavefunctions; while for $r < r_l$ they deviate strongly from spherical wave forms. The relationship of r_l with respect to the atomic radius grossly determines the behavior of the scattering phase shifts. (auth)

9241 FINE STRUCTURE OF O_2^+ MEASURED BY ELECTRON TIME-OF-FLIGHT SPECTROSCOPY. Land, James E.; Raith, Wilhelm (J. W. Gibbs Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Rev. Lett. 30: No. 6, 193-195 (5 Feb 1973).

A high-resolution electron time-of-flight spectrometer has been used in a transmission experiment to study resonances in e-O_2 scattering corresponding to vibrationally excited levels of the $O_2^-{}^2\Pi_g$ ground state. A doublet structure, due to spin-orbit coupling, is observed. The fine structure of O_2^- is measured to be 0.020 ± 0.002 eV, and the energy of the center of the $v'=4$ resonance doublet is measured to be 0.091 ± 0.005 eV. (auth)

9242 EXCITATION OF THE $W^3\Delta_U$, $W^1\Delta_U$, $B^3\Sigma_U^-$, AND $A^1\Sigma_U^-$ STATES OF N_2 BY ELECTRON IMPACT. Chutjian, Ara (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91103); Cartwright, David C.; Trajmar, Sandor. Phys. Rev. Lett. 30: No. 6, 195-198 (5 Feb 1973).

Electron energy-loss spectra have been obtained for N_2 at 20.6 eV impact energy and scattering angles of 10°–138°. These spectra have been analyzed to yield the first identification of excitation to the $W^3\Delta_u$,$W^1\Delta_u$, $B^3\Sigma_u^-$, and $a^1\Sigma_u^-$ states in electron impact spectroscopy, and the angular dependence of the excitations from 10° to 130°. The differential cross section for excitation of the $W^3\Delta_u$ state is the largest triplet-state cross section at all scattering angles, and is the largest inelastic cross section section at angles greater than 70°. (auth)

9243 NONADJACENT VIBRATIONAL TRANSITIONS IN MOLECULAR COLLISIONS. Interference Between One- and Two-Quantum Excitation Processes. Shin, H. K. (Univ. of Nevada, Reno). J. Phys. Chem.; 77: No. 11, 1394-1398(24 May 1973).

The problem of the interference between one- and two-quantum excitation processes in $0 \rightarrow n$ vibrational transitions taking place in molecular collisions was investigated. Specific consideration is given to $0 \rightarrow 1$ and $0 \rightarrow 2$ transitions in H_2-H_2 and I_2-I_2 collisions for which it is found that the interference becomes significant as collision velocities increase. The interference always leads to an increase in the transition probability over the result obtained for purely stepwise processes. For the $0 \rightarrow 2$ transition probability over the result obtained for purely stepwise processes. For the $0 \rightarrow 2$ transition, both stepwise $0 \rightarrow 1 \rightarrow 2$ and direct $0 \rightarrow 2$ excitation processes have to be considered even at moderate velocities in these collision systems. (auth)

9244 THEORY OF SINGLE ELECTRON EXCITATION AND TRANSFER IN NEUTRAL ATOM–ATOM COLLISIONS. Vora, R. B. Knoxville, TN; Univ. of Tennessee (1972). 106p. University Microfilms Order No. 73-12,446.

Thesis (Ph. D.).

A semiclassical approach is used to calculate excitation and charge-transfer cross sections in neutral atom-atom collisions.

Use of single-electron wave functions in a time-dependent perturbation theory gives a set of coupled differential equations. A transformation reduces these equations to a tractable form in a three-state approximation. The formalism is applied to alkali atom-oxygen collisions. The three states are taken to be the ground and the first excited ($^2P_{\frac{1}{2}}$) states of the alkali atom and the single stable state of the O^- ion. Charge-transfer and excitation cross sections are calculated initially in two-state approximations for energies between 10 eV and 10,000 eV. The resulting charge-transfer cross sections generally agree with available results based on Landau-Zener theory. The transition probability for transfer at high velocities is found to vary as $1/v^2$, as in the Born approximation, rather than $1/v$, as predicted from Landau-Zener theory. In the three-state approximation, calculations are performed to study the effects of the simultaneous existence of two final states on the charge-transfer and excitation cross sections. It is found that, in the energy range 10 eV to 10,000 eV, the charge-transfer cross sections remain almost unaffected. The excitation cross sections are considerably altered by the presence of the ionic channel. In particular, at lower velocities they are considerably higher than in the two-state approximation. (Diss. Abstr. Int., B)

9245 TOTAL CROSS SECTIONS FOR SCATTERING OF ELECTRONS BY HELIUM. Poss, E. New York; New York Univ. (1972). 102p. University Microfilms Order No. 73-11, 755.

Thesis (Ph. D.).

Absolute measurements are presented of total cross sections for scattering of electrons by ground-state helium atoms. The atomic recoil technique, which is a crossed electron atom beam method, was used. Data were obtained over electron energy range of 2 to 80 eV with angular resolution of less than 4° and with statistics of better than 1.5% at two selected energies and better than 8% at other energies. The overall uncertainty due to possible systematic sources is estimated as less than ±13%. In the electron energy range below 8 eV the present results are in agreement, to within the experimental uncertainty, with the converted experimental results of Crompton et al., and with the calculations of Duxler et al. Above 8 eV there is a departure of the present results from those of Duxler et al., and from those of Golden and Bandel. (Diss. Abstr. Int., B)

9246 PRECISION MEASUREMENTS OF OPTICAL EXCITATION FUNCTIONS. Heddle, D. W. O. (Univ. of York, Eng.). pp 1-23 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From sixth Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

The discussion of electron excitation functions covers the photon flux, the atomic concentration, and the electron beam current. Also the validity of the initial assumption of simple excitation and radiative loss is treated. (JFP)

9247 NEAR-THRESHOLD BEHAVIOR OF ELECTRON EXCITATION FUNCTIONS IN HELIUM. Kurepa, J. M. (Inst. of Physics, Belgrade); Heddle, D. W. O. pp 25-35 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

The energies for electron excitation functions in helium near threshold are found for various transitions. (JFP)

9248 DIFFERENTIAL CROSS SECTIONS FOR ELASTIC SCATTERING OF ELECTRONS ON ATOMS. Vuskovic, L. D. (Inst. of Physics, Belgrade). pp 65-82 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

The differential cross sections for the elastic scattering of electrons on argon are determined at 60 to 150 eV. (JFP)

9249 EXCHANGE INTERACTION IN ATOMIC SYSTEMS WITH LOOSELY BOUND ELECTRON. Davidovic, D. M. (Boris Kidrich Inst. of Nuclear Sciences, Belgrade). pp 105-116 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

The positive ion–neutral atom systems with loosely bound electrons are studied. One realistic model is given for these systems taking into account both long range polarization and short range atomic forces. In the framework of this model the exchange interaction for the systems A^-A, A^-B, and A^*B are evaluated where A is H, Na, K, Rb, Cs, and O. Using these general results the cross sections for charge exchange reactions H^-–H, O^-–O, for the alkali metals Na^-Na, K^-K, Rb^-Rb, and Cs^-Cs, and for the near resonant process H^-–O are found. (JFP)

9250 LANDAU–ZENER MODEL IN THE THEORY OF ATOMIC COLLISIONS. Nikitin, E. E. (Inst. of Chemical Physics, Moscow). pp 117-135 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

Analytic solutions of the atomic scattering problem are found using quasi-classical scattering conditions and nonadiabatic coupling formulated in terms of simple models. The simplifying procedure for constructing the scattering matrix is discussed. Restriction is made to the linear model of nonadiabatic coupling, which is the development of the Landau–Zener formulation. (JFP)

9251 ASSOCIATIVE, REACTIVE, AND ELECTRON TRANSFER IONIZATION IN CROSSED MOLECULAR BEAMS, Al, Ba, Ta, AND Ti WITH O_2. Cohen, R. B. (Illinois Inst. of Tech., Chicago); Young, C. E.; Wexler, S. Chem. Phys. Lett.; 19: No. 1, 99-103 (1 Mar 1973).

Metal atom beams of Al, Ba, Ta and Ti formed by cathode sputtering were reacted with an O_2 molecular beam, and the positive ionic products measured. The following processes were observed: $M + O_2 \rightarrow MO_2^+ + e^-$ (associative ionization), $M + O_2 \rightarrow MO^+ + O^-$ (reactive ionization), $M + O_2 \rightarrow MO^+ + O_2^-$ (electron transfer ionization), and the product ion angular distributions measured. For some of the systems the dependence of product ion intensity on the velocity of the reactant metal atom was determined. Initial results are presented on the angular distributions for nonvelocity selected metal atom beams, and on the threshold energies for some of the processes. (auth)

9252 DIPOLE MOMENT OF INTERACTING RARE-GAS ATOMS. Bar-Ziv, E.; Weiss, S. (Nuclear Research Center–Negev, Beer Sheva, Israel). Chem. Phys. Lett.; 19: No. 1, 148-150(1 Mar 1973).

The translational absorption spectra of He–Ar and Ne–Ar were analyzed with a hard-sphere potential to obtain the explicit dependence of the interaction dipoles on interatomic distance. The dipoles were found to consist of a short-range part varying almost exponentially with the distance and of a long-range part which varies more slowly. $\mu_{He-Ar}(r)$ exhibited an unexpected maximum at small distances. (auth)

9253 THRESHOLD BEHAVIOR FOR INELASTIC ATOM–ATOM COLLISIONS. Grosser, J. (FOM-Instituut voor Atoom en Molecuulfysica, Amsterdam). Physica; 64: No. 3, 550-560 (15 Mar 1973).

An extension of Wigner's treatment of the threshold behavior of processes with two particles in the entrance and exit channels is given, resulting in a formula which describes the threshold behavior completely for those cases in which the regions of influence of different thresholds do not overlap. (auth)

9254 BOUNDARY DETERMINATION FOR ELECTRON QUASI STATIONARITY USING THE ASYMMETRY OF THE WINGS OF HYDROGEN SPECTRAL LINE PROFILES. Oks, E. A.; Sholin, G. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 3, 217-218(Sep 1972).

Translated from Opt. Spektrosk.; 33: No. 3, 401-404(Sep 1972).

It is shown that the asymmetry of the wings of hydrogen spectral line profiles can be used in an independent determination of the boundary at which the contribution of electrons to the Stark broadening can be considered quasi-static. Using the Lyman-α line as an example, an analysis is performed of the various theoretical descriptions proposed earlier for the transition of electron broadening from collisional to quasi-stationary, showing their inadequacy. (auth)

9255 OPTICAL POLARIZABILITY OF ALKALI METAL ATOMS IN THE QUANTUM DEFECT APPROXIMATION. Shestakov, A. F.; Kristenko, S. V.; Vetchinkin, S. I. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 3, 223-226(Sep 1972).

Translated from Opt. Spektrosk.; 33: No. 3, 413-418(Sep 1972).

Elastic light scattering by alkali metal atoms is investigated in the quantum defect approximation. Green's function was used in the calculations. The usual divergence in the quantum defect approximation was eliminated by the Bates–Damgaard method. The dependence of the dipole dynamic polarizability $\alpha(\omega)$ on the frequency of the external field ω is expressed in analytic form. Values of $\alpha(\omega)$ for the lower S and P states are tabulated over a wide range of ω. (auth)

9256 PHOTOSENSITIZED IONIZATION IN THE CASE OF BINARY COLLISIONS OF 6^2P EXCITED CESIUM ATOMS. Klyucharev, A. N.; Ryazanov, N. S. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 3, 230–232(Sep 1972).

Translated from Opt. Spektrosk.; 33: No. 3, 425–429(Sep 1972).

An experimental evaluation of the effective cross section for the process $2Cs(6^2P) - Cs_2^+ + e$ was carried out in cesium vapor irradiated by the light of resonance lines from a cesium gas-discharge lamp, employing direct quantitative measurement methods for the charged particle current and the concentration of excited atoms. The population of the resonance levels was determined by the method of absorption of lines of the diffuse series of cesium. The pressure of the cesium vapor was 10^{-2} Torr. The ionic current in the saturation regime was measured using an electrometer amplifier, U1-2. The measured average value of the effective cross section for associative ionization in the case of binary collisions of 6^2P excited cesium atoms was found to be $\overline{Q} = (1.1 \pm 0.3) \times 10^{-15}$ cm^2 for T = 450 K. Upon increasing the concentration of 6^2P excited atoms in the cell ($\Sigma N^* \sim 10^{10}$ cm^{-3}), additional mechanisms leading to ionization began to appear in the optically excited cesium vapor. (auth)

9257 VARIATIONAL METHOD FOR COMPUTING THE PHOTOIONIZATION PROBABILITY OF ATOMS. Dmitriev, Yu.Yu.; Yurev, M. S. Opt. Spectrosc. (USSR) (Engl. Transl.). 33: No. 3, 235-237(Sep 1972).

Translated from Opt. Spektrosk.; 33: No. 3, 436–439(Sep 1972).

A variational method is proposed for calculating the photoionization cross section. The use of this method does not require knowledge of the wave function of the continuous spectrum. The relation of this method to the Braun–Rebane variational method for the square of the matrix element of transition probability between states of the discrete spectrum is discussed. The method is illustrated with a calculation of the threshold ionization probability of the hydrogen atom. (auth)

9258 PRODUCT ROTATIONAL STATE DISTRIBUTION IN EXOERGIC ATOM–DIATOMIC MOLECULE REACTIONS. Levine, R. D. (Ohio State Univ., Columbus); Johnson, B. R.; Bernstein, R. B. Chem. Phys. Lett.; 19: No. 1, 1-6(1 Mar 1973).

Product rotational state distributions (measured by Polanyi et al. via IR chemiluminescence) for the reactions Cl + HI/DI, F + H_2/D_2 and H/D + Cl_2 are governed by the fraction of the total energy available for product rotational excitation. The distribution of final rotational states can be characterized by a temperature parameter which is independent of the vibrational state and is isotopically invariant. (auth)

9259 DEPOLARIZATION OF FLUORESCENCE OF ATOMS DUE TO COLLISIONS IN THE PRESENCE OF HYPERFINE STRUCTURE. I. General Theory. Rebane, V. N.; Rebane, T. K. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 3, 219-222(Sep 1972).

Translated from Opt. Spektrosk.; 33: No. 3, 405–412(Sep 1972).

The theory of depolarization of resonance fluorescence under the influence of collisions in the presence of hyperfine structure (HFS) is discussed on the basis of the density matrix method. In view of the break in HFS in the course of collision, the problem of density matrix relaxation is divided into two parts: the dynamic problem of relaxation of the electronic state and the kinematic problem of transformation of sums of the electronic and nuclear moments of momentum. The relaxation equations are derived, and equations defining the fluorescence polarization are given. A series of selection rules for the relaxation matrix elements was found by using the diagram technique of addition of the moments of momentum. It is pointed out that a detailed study of depolarization in the presence of HFS makes it possible to follow the relaxation of higher ($\kappa > 2$) electronic multipole moments of an ensemble of excited atoms. (auth)

9260 FREE–FREE RADIATION IN ELECTRON-NEUTRAL ATOM COLLISIONS. Geltman, S. (Univ. of Colorado, Boulder). J. Quant. Spectrosc. Radiative Transfer; 13: No. 7, 601-613(Jul 1973).

Free–free transition absorption coefficients are calculated for the electron-neutral atom systems involving He, C, N, O, Ne, Ar, Kr and Xe. The calculations are based upon model atomic potentials which were adjusted to fit experimental scattering cross sections or electron affinities. Some angular distributions are presented and thermal averages are evaluated in the ranges $\lambda = 0.5$ to 20 μm and T = 500 to 20,000°K. (auth)

9261 DE-EXCITATION CROSS SECTIONS OF METASTABLE ARGON BY VARIOUS ATOMS AND MOLECULES. Bourène, M.; Le Calvé, J. (C.E.N. Saclay, DRA/SRIRMa, B.P. N°2 91190, Gif s/Yvette, France). J. Chem. Phys. 58: No. 4, 1452-1458 (15 Feb 1973).

The rate constants for the de-excitation of $Ar(^3P_2)$ metastable atoms by many gases were measured, and the corresponding cross sections are calculated. These rate constants were measured in a static system using the $N_2(C^3\Pi_u - B^3\Pi_g)$ emission band at 3371 Å to detect the $Ar(^3P_2)$. The results are compared with those obtained for the quenching of $He(2^3S)$ metastable atoms and for photoabsorption at the argon resonance wavelengths. From these comparisons the de-excitation cross section of metastable atoms appears to be a function of the long range forces and thus it can be presented as a function of the polarizability. (auth)

9262 LINEAR LEAST-SQUARES FITTING OF MOLECULAR-BEAM DIFFERENTIAL CROSS SECTION DATA USING SPLINE FUNCTIONS. Creaser, Roger P. (Metcalf Chemical Laboratories, Brown University, Providence, Rhode Island 02912); English, Richard P.; Kinsey, James L. J. Chem. Phys. 58: No. 4, 1321-1327 (15 Feb 1973).

A method is presented for using spline functions to unfold center-of-mass differential elastic cross sections from scattering data by a linear least squares technique. The role of various averaging processes in reducing structure in the scattered intensity is illustrated. (auth)

9263 COMPLEX-VALUED CLASSICAL TRAJECTORIES FOR REACTIVE TUNNELING IN THREE-DIMENSIONAL COLLISIONS OF H AND H_2. Doll, J. D.; George, T. F.; Miller, W. H. (Inorganic Materials Research Division, Lawrence Berkeley Laboratory and Department of Chemistry, University of California, Berkeley, California 94720). J. Chem. Phys. 58: No. 4, 1343-1351 (15 Feb 1973).

Complex-valued classical trajectories for three dimensional reactive collisions of $H + H_2$ have been calculated at collision energies below the classical threshold for reaction, and from such trajectories classical S-matrix elements for the 0→1 rotational transition have been constructed. Comparison with available quantum mechanical results for the same system are encouraging and suggest that this semiclassical theory is capable of accurately describing reactive tunneling in a physically realistic model of a chemical reaction. Ways of simplifying the practical aspects of applying classical S-matrix theory to three-dimensional reactive systems are also described. (auth)

9264 ELASTIC AND INELASTIC SCATTERING OF ELECTRONS FROM SODIUM ATOM USING GLAUBER APPROXIMATION. Tripathi, A. N.; Mathur, K. C.; Joshi, S. K. (Physics Department, University of Roorkee, Roorkee, India). J. Chem. Phys. 58: No. 4, 1384-1387 (15 Feb 1973).

The Glauber approximation has been applied to study the elastic and the inelastic scattering of electrons from sodium atoms. Adopting a frozen core approximation the total integrated elastic scattering cross section from the ground state of the sodium atoms and the inelastic scattering cross section for the resonance transition (3s–3p) in the sodium atoms are calculated and compared with other theoretical calculations and with the experimental data. With the frozen core assumption and the Glauber approximation, the calculated elastic and inelastic cross sections for the electron sodium atom collisions agree better with experimental data than the results of calculations based on the Born and the cross coupling approximations. (auth)

9265 DOPPLER BROADENING OF OI 1304 Å MULTIPLET IN DISSOCIATIVE EXCITATION OF CO_2 AND O_2. Poland, H. M.; Lawrence, G. M. (Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, Colorado 80302). J. Chem. Phys. 58: No. 4, 1425-1429 (15 Feb 1973).

Emission of the atomic oxygen triplet at 1304 Å produced by electron impact on O_2 and CO_2 was passed through an absorption cell of thermal $O(^3P)$ at 300°K and peak optical depths near 2000. The transmission of the cell varied from 18% to 75%, depending on electron voltage, gas, and viewing angle. Interpretations of the Doppler broadening effect were made in terms of approximate line width, dissociation energy, and excited state symmetry. (auth)

9266 PRODUCTION OF EXCITED OD^+ IN O^+–D_2 COLLISIONS AT LOW RELATIVE ENERGIES (BELOW 4 EV). Harris, H. H. (Department of Chemistry, University of Missouri-St. Louis, St. Louis, Missouri 63121); Leventhal, J. J. J. Chem. Phys. 58: No. 6, 2333-2335 (15 Mar 1973).

The energetics of OD^+ ions formed in collisions of ground state O^+ with room temperature D_2 molecules have been studied at relative energies in the range 0.76–3.58 eV using ion beam techniques. Excited electronic states of OD^+ are inaccessible below about 1.3 eV, so that product internal energy must be vibrational-rotational excitation of ground state ($X^3\Sigma$) OD^+ below this energy. It was found that OD^+ is formed with internal energy over the entire energy range. The spectator stripping mechanism seems to predominate over the entire energy range. (auth)

9267 QUANTUM MECHANICAL CALCULATIONS OF ROTATIONAL-VIBRATIONAL SCATTERING IN HOMONUCLEAR DIATOM-ATOM COLLISIONS. Wagner, Albert F.; McKoy, Vincent (Arthur Amos Noyes Laboratory of Chemical Physics, California Institute of Technology, Pasadena, California 91109). J. Chem. Phys. 58: No. 6, 2604-2620 (15 Mar 1973).

Most calculations of the vibrational scattering of diatom–atom collisions use the breathing sphere approximation (BSA) of orientation averaging the intermolecular potential. The resulting angularly symmetric potential can not cause rotational scattering. We determine the error introduced by the BSA into observables of the vibrational scattering of low-energy homonuclear diatom–atom collisions by comparing two quantum mechanical calculations, one with the BSA and the other with the full angularly asymmetric intermolecular potential. For reasons of economy the rotational scattering of the second calculation is restricted by the use of special incomplete channel sets in the expansion of the scattering wavefuntion. Three representative collision systems are studied: H_2–Ar, O_2–He, and I_2–He. From our calculations, we reach two conclusions. First, the BSA can be used to analyze accurately experimental measurements of vibrational scattering. Second, measurements most sensitive to the symmetric part of the intermolecular potential are, in order, elastic cross sections, inelastic cross sections, and inelastic differential cross sections. Elastic differential cross sections are sensitive to the potential only if the collision is "sticky," with scattering over a wide range of angles; I_2–He is such a collision. Otherwise the potential sensitivity of elastic differential cross sections is concentrated in the experimentally difficult region of very small angle scattering. (auth)

9268 AUTODETACHMENT STATES OF O^-. Matese, John J.; Rountree, Steven P.; Henry, Ronald J. W. (Department of Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana 70803). Phys. Rev. A 7: No. 3, 846-850 (Mar 1973).

A configuration-interaction study of doublet autodetaching states of O^- has predicted the following levels: $O^-[2p^3(^4S^o)3s3p(^2P)]$ at 9.50 eV, $O^-[2p^3(^2D^o)3s^2(^2D^o)]$ at 12.05 eV, and $O^-[2p^3(^2P^o)3s^2(^2P^o)]$ at 13.65 eV. These states can explain most of the structure, which results from collisions of the ground-state O^- ion with rare-gas atoms, as found by Edwards, Risley, and Geballe. An additional level $O^-[2p^3(^4S^o)3p^2(^2P^o)]$ at 10.87 eV is found which has not yet been detected experimentally. The present formalism computes eigenvalues of H_{QQ} using a fixed O^+ core with configuration mixing of states of the outer two active electrons. The shift contribution to the resonance energy is neglected. (auth)

9269 ELECTRON ENERGY LOSSES BY SCATTERING IN SOLIDS. pp 278-322 of Low Energy Electron Spectrometry. Sevier, K. D. New York; John Wiley and Sons, Inc. (1972).

A review is given stressing energy losses due to interband transitions covering plasma excitations, single-electron excitations, photon emission from electron-bombarded foils, bombardment-electron and crystal-lattice interactions, multiple energy losses in solids, and electron energy losses as a secondary effect in electron spectrometry. (JFP)

9270 EXPERIMENTAL STUDY OF THE LOW ENERGY X-RAY INDUCED LUMINESCENCE OF ARGON GAS IN THE REGION 1800 TO 6000 ANGSTROMS. Glancy, J. E. Ithaca, NY; Cornell Univ. (1972). 114p. University Microfilms Order No. 73-6647. Thesis (Ph. D.).

The luminescence from argon gas excited by low energy x-rays was studied in the spectral region from 1800 to 6000 Å. The pressure dependence of the luminescence and the effect of impurities was determined. The characteristic L x-rays of indium and silver, produced by 1 MeV proton bombardment of suitable targets, were selected because their energies lie just above and below the K absorption edge of argon. The luminescence from tank argon (purity 99.996%) shows a number of bands from 3000 to 4100 Å and a continuum at 2200 Å which appeared at pressures above 100 torr. No luminescence was observed above 4100 Å. The bands were identified as the second positive bands of nitrogen and an OH band at 3090 Å. The nitrogen bands were removed by purification and increased in intensity upon the addition of nitrogen, peaking at a nitrogen concentration of 3%. The OH band could not be completely removed and was attributed to outgassing of water vapor from the gas cell walls. The only luminescence from argon is the continuum at 2200 Å which showed a quadratic pressure dependence apparently due to the formation of excited argon molecules by three body collisions involving one of the low lying resonance states of the argon atom. The results are independent of the x-ray energy and are in good agreement with experiments on the luminescence of argon excited by charged particles. The luminescence is therefore attributed to excitation of low lying argon resonance levels by the auger and photoelectrons emitted following x-ray absorption while no luminescence from the multiply ionized atoms and molecules resulting from inner shell ionization by x-rays was observed in the wavelength region studied. (Diss. Abstr. Int., B)

9271 THEORY OF COLLISIONS OF FAST MANY-ELECTRON ATOMS. Dozorov, A. A. (Yaroslavl Technological Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 54-58(1973). (In Russian).

Equations are advanced for the collision cross sections of fast neutral atomic particles. It is shown that a theoretical examination of inelastic collisions of atomic particles may apply, to a first Born approximation, to many-electron atoms, for which there are required only a knowledge of atomic form factors. One may consider the collision of ionized atoms in a strictly analogous way. (KSW)

9272 ASSOCIATIVE IONIZATION IN SLOW COLLISIONS BETWEEN ATOMS. 2. Koike, F. (Tokyo Univ.); Nakamura, H. J. Phys. Soc. Jap.; 33: No. 5, 1426-1435(Nov 1972).

Associative ionization between atoms in slow collisions $A^* + B \rightarrow AB^+ + e$ is investigated theoretically for the case in which the excitation energy of A^* is smaller than the ionization potential of B. Two cases are considered. First, on the basis of the adiabatic or diabatic representation, a general treatment is described for the case involving a potential curve crossing. In the second case of no potential curve crossing the cross section formula is presented which does not require numerical differentiations and thus is of practical usefulness. A rough estimate of the energy dependence of the cross section is also discussed in this case. Some qualitative applications to a hydrogen system are made. (auth)

9273 EXCITATION OF HELIUM BY PROTONS AND ALPHA PARTICLES. Roy, K.; Mukherjee, S. C. (Indian Association for the Cultivation of Science, Calcutta). Phys. Lett.; 44A: No. 2, 147-148(21 May 1973).

The excitation cross sections for H^+–He and He^{++}–He collisions are calculated by the distortion approximation. The present results are compared with other existing results. The cross sections for He^{++}–He collisions reveal an oscillatory nature. (auth)

9274 EXPERIMENTAL ENERGY DEPENDENCE OF ALUMINIUM MULTIPLE INNER-SHELL IONIZATION FROM 3.0 TO 30.0-MeV OXYGEN BOMBARDMENT. Olsen, D. K.; Moore, C. F.; Kauffman, R. L. (Univ. of Texas, Austin). Phys. Lett., 44A: No. 2, 109-111(21 May 1973).

Aluminium, K_α, relative-satellite, x-ray yields for initial ionization states with 0, 1, 2, 3, 4, and 5 additional L-shell vacancies produced from 3.0 to 30.0 MeV oxygen bombardment are shown to be consistent with a multiple-Coulomb reaction mechanism. (auth)

9275 NUMERICAL CALCULATION OF IONIZATION CROSS-SECTION RATIOS OF ATOMS FOR CIRCULARLY VERSUS LINEARLY POLARIZED LIGHT. Parzynski, R. (Univ., Poznan, Poland). Acta Phys. Pol.; A43: No. 5, 741-743(May 1973).

Four-photon direct ionization to a state with low kinetic energy of the photoelectron is more effective in linearly than in circularly polarized light. For ionization to high photoelectron energy (close to that of a photon) the situation is the inverse. (auth)

9276 EFFECT OF REACTANT VIBRATIONAL ENERGY ON SPECTATOR STRIPPING PRODUCT DISTRIBUTIONS. Kuntz, P. J. (Univ. of Wisconsin, Madison). Chem. Phys. Lett.; 19: No. 3, 319-322(1 Apr 1973).

Simple expressions are given for product angular and translational energy distributions of the bimolecular reaction $A + BC \rightarrow AB + C$ assuming a spectator stripping mechanism which includes the effect of BC vibrational energy. (auth)

9277 FINITE-DIFFERENCE APPROACH TO LONG-RANGE INTERACTIONS. Stewart, R. F.; Webster, B. C. (Univ. of Glasgow). Chem. Phys. Lett.; 19: No. 3, 462-464(1 Apr 1973).

Finite-difference methods were used to obtain the interaction energy to second order for the ground state and 1S2S excited states of two hydrogen atoms at long-range. (auth)

9278 IMPACT DISSOCIATIONS OF H_2^+ IONS IN THE $1s\sigma_g$ STATE. Meierjohann, B. (Univ., Giessen, Ger.). Physica; 65: No. 1, 41-62(1 Apr 1973). (In German).

The velocity distribution of protons from collision-induced dissociations of H_2^+ ions in the $1s\sigma_g$ state is calculated classically. For the potential of the target atom a screened argon potential is used. The ions have a laboratory energy of 20.4 keV. (auth)

9279 FORM FACTORS, ATOMIC POTENTIALS, AND ELASTIC SCATTERING. Riewe, F. E.; Wallace, S. J.; Green, A. E. S. (Department of Physics and Astronomy, University of Florida, Gainesville, Florida 32601). Phys. Rev. A 7: No. 3, 880-886 (Mar 1973).

We present a treatment of ion–atom and atom–atom potentials based on terms derived from the separated atoms or ions. The method used is an adaption of form–factor techniques developed in particle and nuclear physics. The potentials of the separated atoms or ions are derived from an independent–particle model for atoms and the resulting ion–atom and atom–atom potentials are shown to be representable as sums of exponentially shielded Coulomb potentials, or Yukawa potentials. We then calculate the differential cross sections using an eikonal model which embodies systematic analytic corrections to the Glauber approximation. Analytic results are also obtained for the scattering amplitude at nonforward angles by employing the stationary–phase approximation. The specific case of O^+–Ar at 100 keV is treated. Exchange effects, polarization, and inelasticity are neglected. (auth)

9280 IONIZING COLLISIONS OF TWO METASTABLE HELIUM ATOMS (2^3S)*. Johnson, A. Wayne; Gerardo, J. B. (Sandia Laboratories, Albuquerque, New Mexico 87115). Phys. Rev. A 7: No. 3, 925-928 (Mar 1973).

The rate coefficient β_1 for the ionizing collision of two metastable helium atoms ($2\ ^3S$) is evaluated from measurements in a steadily decaying helium afterglow plasma with three different techniques. The value of β_1 is also determined with a perturbation technique. All the values of β_1 determined by these techniques lie within the range $(4.5\pm1.0)\times10^{-9}$ cm^3 sec^{-1}. This value is larger than that observed directly from the decay of the density of the triplet helium metastable atom because the dissociative recombination of He_2^+ is a significantly large source of atomic metastables. (auth)

9281 ENERGY DEPENDENCE OF THE TOTAL CROSS SECTION FOR HE–HE COLLISIONS FROM 0.30 TO 3.00 KEV. Savola, W. J. Jr.; Eriksen, F. J.; Pollack, E. (Physics Department, University of Connecticut, Storrs, Connecticut 06268). Phys. Rev. A 7: No. 3, 932-937 (Mar 1973).

The total cross section for scattering of He by He is measured at 100–eV intervals in an energy range from 0.30 to 3.00 keV. Measurements are made using detector angular resolutions of 0.056° and 0.260°. The cross section is found to decrease monotonically from 12.5 to 5.0 Å^2 and from 7.0 to 2.6 Å^2, respectively, as the energy increases. Small–angle differential measurements are also made out to scattering angles of 1.25° at incident energies of 1.80 and 3.00 keV. At 3.00 keV a He^+ signal is found at scattering angles beyond 0.8°. The ratio of the ion to the total signal increases to about 10% at 1.25°. The total cross–section data are used to infer a potential. (auth)

9282 SCATTERING BETWEEN Hg ATOMS AND LIGHT ATOMIC PROJECTILES OF KEV ENERGIES. van Wijngaarden, A.; Baylis, W. E. (Univ. of Windsor, Ont.). Phys. Rev. A; 7: No. 3, 937-942(Mar 1973).

Previously described measurements for the scattering of $^1H^+$, $^4He^+$, $^{11}B^+$, and $^{14}N^+$ ions of energies $9<E<75$ keV by a thermal beam of Hg atoms have been extended to smaller angles. Angular distrubtuions for $2.8<\theta_L<40$ deg have been measured for the scattering of all projectiles independent of final charge state. Differential scattering cross sections are in approximate agreement with the theory for scattering in a Thomas–Fermi potential over a range of five orders of magnitude. When the cross sections are reduced by the Lindhard procedure, we find the the Thomas–Fermi interaction is a better approximation to the actual potential than the Lenz–Jensen interaction. (auth)

9283 MOLECULAR THEORY OF ATOMIC COLLISIONS: FINE–STRUCTURE TRANSITIONS. Mies, F. H. (National Bureau of Standards, Washington, D.C. 20234). Phys. Rev. A 7: No. 3, 942-957 (Mar 1973).

The theory of fine–structure transitions in atom–atom collisions is formulated in terms of the molecular states of the diatomic collision complex. The Born–Oppenheimer (B.O.) electronic wave functions are implicit functions of the interatomic coordinate R, and the molecular theory is analogous to the "perturbed–stationary–state" method. Expansion in molecular channel states incorporates the effects of polarization, exchange, and valence forces on the electronic portion of the scattering wave function and embodies the "adiabatic" contribution of the entire set of closed–channel excited states that are generated in the more usual asymptotic–atomic–state expansion. The channel states are expressed explicitly in terms of the body–fixed molecular wave functions, and the resultant interaction matrix elements in the close–coupling scattering formalism are related to the molecular potentials. The theory is developed specifically for proton collisions with the fluorine atom in its ground $^2P_{j,mj}$ state, with explicit account being taken of the spin–orbit splitting between the $j=3/2$ and $j=1/2$ multiplet states. Use is made of the accurate $HF^+(^2\pi)$ and $HF^+(^2\Sigma)$ wave functions calculated by Wahl, Julienne, and Krauss. These molecular states asymptotically approach $H^+ + F(^2P)$, and accurate quadrupole and induced–dipole interaction parameters which describe the asymptotic interaction potentials are obtained from the calculations. Estimates are made of the B.O. coupling terms and they are found to be negligible compared to the spin–orbit couplings. In the following paper close–coupling calculations are made of the cross sections for the fine–structure transitions $(j,m_j–j',m_{j'})$. (auth)

9284 MOLECULAR THEORY OF ATOMIC COLLISIONS: CALCULATED CROSS SECTIONS FOR $H^+ + F(^2P)$. Mies, F. H. (National Bureau of Standards, Washington, D. C. 20234). Phys. Rev. A 7: No. 3, 957-967 (Mar 1973).

The results of a close–coupling calculation of the fine–structure transitions $(j,m_j–j',m_{j'})$ are presented for collisions between protons and $F(^2P_{j,mj})$. The theory is formulated in the perturbed–stationary–state approximation using accurate molecular wave functions for the ground $^2\Pi$ and $^2\Sigma$ states of HF^+. Comparison is made to the predictions of the Born approximation. The magnetic selection rule $(j,m_j/j,–m_j)$ is strongly violated in the $j=3/2$ state and less strongly violated in the $k=1/2$ state. It is concluded that the important region of interaction for the $j=1/2$–$j=3/2$ transition is at short–to–intermediate distances where accurate molecular potentials are required and close–coupling effects are dominant. (auth)

9285 MEASUREMENT OF THE LIFETIME AND THE ELECTRON–IMPACT EXCITATION CROSS SECTION AND POLARIZATION OF THE 2 ^3P TERM OF SINGLY IONIZED LITHIUM. Adler, A.; Kahan, W.; Novick, R. (Columbia Radiation Laboratory, Columbia University, New York, New York 10027); Lucatorto, T. Phys. Rev. A 7: No. 3, 967-972 (Mar 1973).

The lifetime of the 2 ^3P_j states in singly ionized lithium has been measured using an rf magnetic–resonance technique; the value is $\tau=45\pm5$ nsec. Neutral lithium was ionized and excited by a unidirectional beam of electrons which produced an alignment in the excited state. The cross section for the electron–impact excitation 1s ^{2}2s ^{2}S→1s2p ^{3}P near threshold was measured to be $10^{-22\pm1}$ cm^2. Implications for the feasibility of rf resonance spectroscopy on the fine and hyperfine structure of the 2 ^3P term will be discussed. (auth)

9286 GLAUBER THEORY OF ATOMIC–HYDROGEN IONIZATION BY ELECTRON IMPACT. McGuire, J. H. (Department of Physics, Kansas State University, Manhattan, Kansas 66506); Hidalgo, M. B.; Doolen, G. D.; Nuttall, J. Phys. Rev. A 7: No. 3, 973-979 (Mar 1973).

The high–energy Glauber, or eikonal, approximation is used to derive formulas for the scattering amplitude and cross section for the ionization of atomic hydrogen by electron impact. The scattering amplitude is expressed in terms of a double infinite sum of hypergeometric functions which may be evaluated on a computer. Total cross sections may be obtained by squaring the scattering amplitude and integrating over five final–state variables. Three integrals are trivial and two must be done numerically. At sufficiently high energies, the Glauber result reduces to the expressions found in the simpler, but more restrictive, Coulomb–Born approximation. (auth)

9287 X–RAY SCATTERING BY ATOMS BY USING THE THOMAS–FERMI MODEL WITH QUANTUM CORRECTIONS. Enstrom, James E. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). Phys. Rev. A 7: No. 3, 979-983 (Mar 1973).

Using an accurate numerical solution of the Thomas–Fermi model with quantum–mechanical corrections, the author obtains a description of coherent and incoherent scattering of x rays by the inert gases, which is in excellent agreement with detailed Hartree–Fock calculations. The results are somewhat better than those given by the Thomas–Fermi–Dirac model, and are a substantial improvement over those given by the Thomas–Fermi model alone. (auth)

9288 UNIVERSAL CROSS SECTIONS FOR K–SHELL IONIZATION BY HEAVY CHARGED PARTICLES. I: LOW PARTICLE VELOCITIES. Basbas, George; Brandt, Werner; Laubert, Roman (Department of Physics, New York University, New York, New York 10003). Phys. Rev. A 7: No. 3, 983-1001 (Mar 1973).

Experimental K–shell ionization cross sections are reported for low–velocity heavy projectiles of atomic number small compared to the target atomic number. For such projectile–target combinations, the Coulomb interaction between the projectile nucleus and the K–shell electrons dominates the K–shell ionization process at all projectile velocities. The data can disagree by orders of magnitude with the primary predictions of the nonrelativistic quantum theory in the plane–wave Born approximation. Important physical processes are shown to be at the root of the discrepancies. They derive from the finite charge of the moving projectile, and thus do not contribute in the plane–wave Born approximation. They are the Coulomb deflection of the projectile in the field of the target nucleus and the perturbation of the target atomic states by the projectile. A theory for these processes is developed in an approximate manner. When incorporated with the theory in the plane–wave Born approximation, it accounts quantitatively for the data. A method of reducing cross–section data in a comprehensive way results. A universal graph of cross sections emerges which, in effect, constitutes an extrapolation of the data to the conditions of zero projectile charge. It comprises cross sections ranging over six orders of magnitude measured on different targets for various projectiles with a wide range of velocities, mostly below the mean K–shell velocities. The locus of this universal graph coincides with the prediction of the plane–wave Born approximation. (auth)

9289 TOTAL GAMMA-RAY CROSS SECTIONS IN THE ENERGY REGION 60-1400 KEV. Rao, K. Sivasankara; Rao, B. V. Thirumala; Rao, B. Mallikarjuna; Rao, V. Visweswara; Parthasaradhi, K. (The Laboratories for Nuclear Research, Andhra University, Visakhapatnam, India). Phys. Rev. A 7: No. 3, 1001-1003 (Mar 1973).

Total γ-ray cross sections at 12 γ energies (most of them are at new energies) are determined in Cu, W, and Pb and the results are reported. The error in these results is of the order of 1%. An analysis of the data is presented. (auth)

9290 RESONANCES IN THE METASTABLE EXCITATION OF MOLECULAR NITROGEN. Lawton, S. A.; Pichanick, F. M. J. (Department of Physics and Astronomy, University of Massachusetts, Amherst, Massachusetts 01002). Phys. Rev. A 7: No. 3, 1004-1007 (Mar 1973).

The excitation function for metastable molecular nitrogen has been studied over the electron-impact energy range 7-14 eV with an energy resolution of 0.05 eV. No resonances were observed below 11.8 eV in the A $^3\Sigma_u^+$ and a $^1\Pi_g$ channels. There is a sharp resonance at the threshold of the metastable E $^3\Sigma_g^+$ with a peak at 12.00 eV. Smaller structures were seen at 12.14 and 12.25 eV. A series of five resonances were observed at 12.59, 12.80, 13.03, 13.24, and 13.52 eV presumably in one or both of the A $^3\Sigma_u^+$ and a $^1\Pi_g$ channels. These confirm some of the structures observed in a recent transmission experiment. On the basis of the spacings and relative intensities of these resonances, a possible assignment for them is a temperary state of N_2^- consisting of two Rydberg electrons around a core state A $^2\Pi_u$ Of N_2^+. (auth)

9291 SEMICLASSICAL COLLISION THEORY WITHIN THE FEYNMAN PATH-INTEGRAL FORMALISM. Penner, A. P.; Wallace, R. (Department of Chemsitry, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2). Phys. Rev. A 7: No. 3, 1007-1015 (Mar 1973).

A multichannel semiclassical collision theory, based on Feynman's path-integral formulation of quantum mechanics and developed by Pechukas, is discussed. The theory is applied to low-energy, elastic and inelastic, collisions between He^+ and Ne. The calculation involves the solution of a boundary-value problem, and a numerical method for obtaining this solution is presented. The numerical results and the qualitative interpretation of them are compared with the predictions of other available theories. (auth)

9292 STURMIAN EXPANSION OF THE COULOMB T MATRIX. Sloan, Ian H. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. A 7: No. 3, 1016-1023 (Mar 1973).

The convergence of the Sturmian expansion (i.e., the Weinberg series) for the Coulomb t matrix at negative energies is discussed. It is pointed out that the series for the full three-dimensional t matrix diverges, and that the series for the partial-wave t matrix converges conditionally at best and sometimes diverges because of the long range of the Coulomb potential. The t matrix is rigorously expressed as the limit of a power series at a point on its circle of convergence, with the power series itself at that point being just the Sturmian expansion. The possibility of finding alternative separable expansions with better convergence behavior is discussed, the conclusion being reached that the poor convergence is an inevitable result of the long range of the Coulomb potential. (auth)

9293 ELASTIC ELECTRON-NEUTRAL-ATOM INTERACTION MEASUREMENTS IN HELIUM AT ULTRALOW ENERGIES. Sol, C.; Boulmer, J.; Delpech, J.-F. (Groupe d'Electronique dans les Gaz, Institut d'Electronique Fondamentale, Laboratoire associé au Centre National de la Recherche Scientifique, Bâtiment 220, Université Paris XI, Centre d'Orsay-91405 Orsay, France). Phys. Rev. A 7: No. 3, 1023-1028 (Mar 1973).

The cross section σ_{mt} for the elastic momentum transfer of electrons with helium atoms at ultralow energies has been deduced from measurements of the microwave absorptivity of a transient cryogenic afterglow plasma. The electrons were selectively heated by an adjustable-microwave electromagnetic field. This cross section can be approximated as a function of the incident electron kinetic energy u_e between 2×10^{-4} and 10^{-1} eV by $\sigma_{mt}(cm^2)$ $=5.15\times10^{-16}(u_e(eV)/2\times10^{-4})^{0.02}$. (auth)

9294 SCALING RULE IN LOW-ENERGY ATOM-ATOM SCATTERING. Mittleman, Marvin H. (Physics Department, The City College of the City University of New York, New York, New York 10031). Phys. Rev. A 7: No. 3, 1188-1190 (Mar 1973).

An energy-scaling rule for atom-atom scattering is derived. It is shown to be approximately accurate to third order in the parameter $\Delta M/M_{av}$, where ΔM is the difference in the reduced masses between two different atomic pairs. The energy scaling depends upon the energy itself and on the interaction potential. The method is illustrated by the He-He scattering problem using the isotopes He_3 and He_4 in their three different combinations. (auth)

9295 CHARACTERISTIC L X-RAY SPECTRA FROM PROTON, α-PARTICLE, AND OXYGEN BOMBARDMENT OF SN. Olsen, David K.; Moore, C. Fred; Richard, Patrick (Center for Nuclear Studies, University of Texas, Austin, Texas 78712). Phys. Rev. A 7: No. 4, 1244-1248 (Apr 1973).

Spectra have been measured [using a crystal (LiF;200) spectrometer] of L x rays produced by 2.0-MeV proton, 3.2-MeV α-particle and 30.0-MeV oxygen bombardment of thick tin targets. L x ray lines are observed in the α-particle-produced spectrum from initial configurations with up to four additional M-shell electron vacancies. The energy resolution of 8 eV (full width at half-maximum) did not allow any detailed structure to be resolved in the oxygen bombardment; an almost continuous structure is observed from multiply ionized tin. The ratios of x-ray yields from L+M vacancies to yields from L vacancies are shown to have the correct order of magnitude for a simultaneous direct Coulomb ionization process for proton and α-particle impact. (auth)

9296 LOW-ENERGY-ELECTRON SCATTERING AMPLITUDES. II. VALIDITY OF FREE-ELECTRON-GAS EXCHANGE APPROXIMATIONS APPLIED TO ELECTRONS INCIDENT ON HG. Gregory, D.; Fink, M. (Physics Department and Electronic Research Center, The University of Texas at Austin, Austin, Texas 78712). Phys. Rev. A 7: No. 4, 1251-1256 (Apr 1973).

For the test case of 300-eV electrons incident on Hg the influence of the exchange of the incoming electron with the atomic electrons is studied. Four different approximations for the derivation of an exchange potential based on the free-electron-gas description are discussed. These approximate exchange potentials were employed in calculations of electron scattering factors. The comparison of those results with a rigorous Hartree-Fock (HF) treatment of the total scattering problem (N+1 particles) shows that the exchange given by Kohn and Sham is too large, especially at large atomic distances. By Gombás's introduction of a cutoff at the radius of the Thomas-Fermi-Dirac atom, the long tail of the potential was avoided. While the truncated results of Gombás decrease the deviations significantly, a different treatment of the self-exchange as suggested by Lindgren and Rosen brings the best agreement with the HF calculation. The theoretical results show that precise relative measurements in the valleys of the different cross sections are an extremely sensitive tool for testing scattering theory. (auth)

9297 SLOW ELECTRONS EJECTED FROM He BY FAST CHARGED PARTICLES. Kim, Yong-Ki; Inokuti, Mitio (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. A 7: No. 4, 1257-1260 (Apr 1973).

An accurate differential ionization cross section for the ejection of zero-kinetic-energy electrons from He by fast charged particles is deduced by extrapolating the Born cross sections for discrete excitations, in the spirit of the quantum-defect theory. Recent electron-impact data by Grissom et al. for secondary electrons of almost zero kinetic energy are in excellent agreement with the theory. The electron-impact data by Peterson et al. for slow secondary electrons show trends consistent with the theory also. The proton-impact data by Rudd et al. are in better agreement with the theory than those by Stolterfoht. (auth)

9298 TOTAL DIFFERENTIAL CROSS SECTION FOR SCATTERING OF PROTONS BY HELIUM AND ARGON. Crandall, D. H. (Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, Colorado 80302); McKnight, R. H.; Jaecks, D. H. Phys. Rev. A 7: No. 4, 1261-1268 (Apr 1973).

Measurements for the differential scattering of protons by helium and argon as a function of scattering angle and impact energy are presented for the range 3-20 keV and 1°-5° laboratory angle. The measurements are of the sum of elastic, inelastic, and charge-changing collisions. Comparison is made with two classical calculations, one employing the Bohr screening length, the other employing separate screening lengths for each electronic shell. For argon, the data are in significantly better agreement with the calculation employing separate screening lengths for each electronic shell. (auth)

Atomic Theory

Refer also to abstracts 8271 and 9924.

9299 BOHR-SOMMERFELD ORBITS AND QUANTIZABLE SYMPLECTIC MANIFOLDS. Simms, D. J. (Trinity Coll., Dublin). Proc. Cambridge Phil. Soc.; 73: No. 3, 489-491(May 1973).

The phase space of a finite dimensional classical Hamiltonian system is a C^∞ differentiable manifold M which carries a C^∞ differential 2-form ω which is closed, $d\omega = 0$, and nonsingular in the sense that there is a bijective map $\alpha \to X_\alpha$ from covariant vector fields to contravariant vector fields satisfying the identity $\omega(X, X_\alpha) = \alpha(X)$. Such a pair (M,ω) is called a symplectic manifold. The 2-form ω defines a real cohomology class $[\omega] \in H^2(M, R)$. The

symplectic manifold (M,ω) is said to be quantizable if $[\omega]$ lies in image of the natural map $H^2(M,Z) \rightarrow H^2(M,R)$. For compact M this is equivalent to the statement that the periods of ω (the integrals of ω over integral 2-cycles) are all integers. This quantization condition plays a fundamental role in Kostant's (1970) theory of unitary representations of Lie groups, and in Souriau's (1970) theory of geometric quantization. It is shown that the quantization condition, when applied to the 4-dimensional compact manifold of Kepler orbits of fixed negative energy E, yields energy levels which are proportional to those of Bohr-Sommerfeld-Wilson. (UK)

9300 SUGGESTIONS FOR IMPROVING THE USE OF GAUSSIAN LOBE FUNCTIONS FOR ATOMIC OR MOLECULAR CALCULATIONS. Deutsch, P. W.; Kunz, A. Barry (Department of Physics and Materials Research Laboratory, University of Illinois, Urbana, Illinois 61801). J. Chem. Phys. 58: No. 4, 1779-1780 (15 Feb 1973).

It is found that when employing a small Gaussian basis, considerable improvements in the total Hartree–Fock ground state energy occur upon giving the one electron orbitals full benefit of the expansion set. The total energy is found for the Ne and Ne^{6+} and for CH_4. (JFP)

9301 ALL-PAIR WAVEFUNCTION FOR MANY-ELECTRON STATES WITH THE HIGHEST MULTIPLICITY. Naray-Szabo, G. (Univ., Goettingen, Ger.). J. Chem. Phys.; 58: No. 4, 1775-1776 (15 Feb 1973).

From a previous ansatz for describing correlation effects of an N-electron system in which the wave function is a product of a spin part and different geminals, $u_{ij}(ij)$, one for each pair of electrons, a general equation for the geminal u_0 is derived. A straightforward way is found to generalize the results for the hypothetical atom with $N \rightarrow \infty_{\odot}$ (JFP)

9302 LOW ENERGY ELECTRON SPECTROMETRY. Sevier, K. D. New York; John Wiley and Sons, Inc. (1972). 411p.

The book included eight chapters. Separate abstracts were prepared for seven chapters. Other chapters were outside the scope of NSA. (JFP)

For abstracts of individual chapters see: 8271, 9269, 9303–9305, 9716, and 9717.

9303 AUGER, COSTER–KRONIG, AND AUTOIONIZATION EFFECTS. pp 51-178 of Low Energy Electron Spectrometry. Sevier, K. D. New York; John Wiley and Sons, Inc. (1972).

The review covers sources and classification of Auger electrons the K-, L-, and M-series energies and relative intensities for the Auger and Coster–Kronig effects, autoionizing levels in atoms, angular distribution of Auger electrons, fluorescence yields for K-, L-, and M-shells and their measuring techniques, the Auger effect, and the Auger transition process for determining nuclear and atomic properties and for industrial and technical purposes. The work up to the middle of 1969 is covered. (JFP)

9304 NATURAL WIDTHS OF ATOMIC LEVELS. pp 220-241 of Low Energy Electron Spectrometry. Sevier, K. D. New York; John Wiley and Sons, Inc. (1972).

X-ray emission and absorption spectra, photoelectron, internal conversion, and Auger electron lines, and atomic level widths are discussed. (JFP)

9305 ATOMIC ELECTRON BINDING ENERGIES. pp 242-277 of Low Energy Electron Spectrometry. Sevier, K. D. New York; John Wiley and Sons, Inc. (1972).

The method of determining binding energies from various electron spectrometry procedures is considered. Theoretical and experimental determinations of atomic electron binding energies and alterations of electron binding energy values are discussed. (JFP)

9306 CONCEPT OF FREE-FALL MULTI-ELECTRON ATOMIC MODEL. Gryzinski, M. (Inst. for Nuclear Research, Swierk, Poland). Phys. Lett.; 44A: No. 2, 131-132(21 May 1973).

It is shown that multi-electron configurations consisting of positively charged nucleus and symmetrically situated synchronously moving over the free-fall trajectories electrons may be considered as the rough model of an atomic shell. (auth)

9307 COMMENTS ON SCREENING AND SHELL-RATIO EFFECTS IN SINGLE-QUANTUM PAIR ANNIHILATION. Tseng, H. K.; Pratt, R. H. (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). Phys. Rev. A 7: No. 4, 1423-1426 (Apr 1973).

We show that atomic–electron screening and subshell–ratio effects in single–quantum pair annihilation, reported by Broda and Johnson and by Sheth and Swamy, have a simple origin observed also in pair production and atomic photoelectric effect. In all three processes, the characteristic distances are small on an atomic scale, but large on a nuclear scale; wave functions have a point–Coulomb shape, but not the point–Coulomb normalization. Atomic–electron screening effects cause appreciable modifications of the total pair–annihilation cross section for positron energies below $1.5m_ec^2$ in heavy elements ($Z > 47$). For low–Z elements, screening effects are always important. The n^3 rule of Bethe for subshell ratios is good only for low–Z elements (where n is the principal quantum number); we find that the subshell ratio between the K and L_I single–quantum pair–annihilation cross sections is well predicted by the square of the ratio of the K and L_I bound–electron wave–function normalizations. (auth)

9308 LOCAL-EXCHANGE POTENTIAL FOR THE RELATIVISTIC HARTREE-FOCK EQUATIONS. Miller, L. D. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). Phys. Rev. A 7: No. 4, 1433-1436 (Apr 1973).

An exact local representation of the relativistic Hartree–Fock exchange potential for electrostatic interactions is presented for closed–shell atoms. This single–particle potential depends upon all relativistic single–particle quantum numbers except the magnetic quantum number m. This exchange potential should be useful for relativistic atomic Hartree–Fock calculations. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

9309 (AD-753149) EXTENSION OF THE MHD JEFFERY–HAMEL FLOW. Technical Summary Report. Ranger, K. B. (Wisconsin Univ., Madison. Mathematics Research Center). Oct 1972. Contract DA-31-124-ARO(D)-462. 17p. (MRC-TSR-1280). NTIS.

An extension of the M. H. D. Jeffery Hamel flow is found which exhibits laminar separation at one wall, even for vanishingly small Reynolds and magnetic Reynolds numbers. (auth)

9310 (AD-755060) MAGNETOHYDRODYNAMIC STREAMING FLOW PAST A SPHERE AT LOW HARTMANN NUMBERS. Technical Summary Report. Mathon, R.; Ranger, K. B. (Wisconsin Univ., Madison. Mathematics Research Center). Nov 1972. Contract DA-31-124-ARO(D)-462. 21p. (MRC-TSR-1275). NTIS.

The streaming flow of a weakly conducting viscous fluid past a nonconducting sphere in the presence of an aligned uniform magnetic field is investigated for low Hartmann number using a Galerkin method. If convection effects are neglected it is found that eddies occur symmetrically fore and aft of the sphere when the Hartmann number exceeds 2.9. (auth) (NTIS)

9311 (AD-755944) INVESTIGATIONS ON THE DYNAMICS OF MHD FLOWS. Annual Technical Report No. 4, 1 January–31 December 1972. Wilhelm, H. E. (Colorado State Univ., Fort Collins (USA). Dept. of Physics). 15 Jan 1973. Contract N00014-67-A-0299-0008. 104p. NTIS.

Theoretical investigations were performed on the steady state dynamics of compressible plasma flows across inhomogeneous magnetic fields in ducts with plane inclined walls (diffusers). By means of a similarity transformation, an exact analytical solution in terms of a hyperelliptic integral is derived for the fields of the polytropic flow of a compressible plasma across an azimuthal magnetic field. Mathematical theorems are proven which show the applicability of the similarity transformation to symmetric outflows (diffuser flows). A similarity transformation is presented which reduces the general partial differential equations for a plasma flow in a diffuser (with viscous momentum transfer, ohmic and viscous heating, and heat conduction) to ordinary nonlinear differential equations which are readily integrable by numerical methods. The associated boundary-value problem for the ordinary differential equations is formulated and discussed. (auth)

9312 BAECKLUND TRANSFORMATIONS IN ALIGNED NON-DISSIPATIVE MAGNETOGASDYNAMICS. Rogers, C. Rev. Roum. Sci. Tech., Ser. Mecan. Appl.; 15: No. 2, 371-380(1970).

Iu'rev (1962) established hodograph equations for certain aligned magnetogasdynamic flows. Baecklund-type matrix transformations are applied to this hodograph system which is thereby reduced to consideration of the Cauchy-Riemann equations in elliptic regions and to the wave equation in hyperbolic regimes. By suitable specialization of the matrices involved, magnetogasdynamic analogs of the reciprocal and adjoint relations of ordinary gas dynamics are derived. A generalized Karman-Tsien is established which reduces to the well known linear (p, ρ^{-1})- relation of conventional gas dynamics in the limit $A \to \infty$, where A is the Alfven number. Similarly, analogs of the Peres and Dombrovskii transformations are readily constructed. Finally, the method is employed to approximate certain super-Alfvenic flows of an adiabatic gas past an insulated body. (Applied Mechanics Reviews)

9313 REPLY TO COMMENTS BY S. A. RYCE. Pfeifer, R. J. (Industrial Nucleonics Corporation, Columbus, Ohio 43202). Phys. Fluids 16: No. 3, 454-455 (Mar 1973).

It is stated that the application of the fissionability concept to the hypothetical parent drop permits categorization of a wide range of electrohydrodynamic spraying phenomena independently of the details of spraying and thus complements and extends the physical model. (CES)

9314 COMMENTS ON CHARGE-TO-MASS RELATIONSHIPS FOR ELECTROHYDRODYNAMICALLY SPRAYED LIQUID DROPLETS. Ryce, S. A. (Department of Chemistry, University of Victoria, Victoria, B. C., Canada.). Phys. Fluids 16: No. 3, 452-453 (Mar 1973).

It is postulated that the character of electrically induced surface instabilities is determined at capillary points by the degree to which a hypothetical parent drop is charged above or below the Rayleigh instability condition. This degree of charge is measured by a parameter y, analogous to the concept of fissionability in the liquid drop model of the nucelus. (CES)

9315 APPLICATION OF THE EXTENDED KANTOROVICH METHOD TO MHD DUCT FLOW. Alexander, H. Acta Mech.; 11: No. 3-4, 171-183(1971).

The application of approximation methods developed for analysis of thin plate structures to the problem of viscous electrically conducting fluid flow in a channel with an external magnetic field is described. Reasonable agreement is found with the results of other solutions to Hartmann flows, but no improvement in accuracy is obtained with this technique. It is felt that transfer of this useful analytical method from mechanics to fluid mechanics is valuable, but the discussion does not add to a basic understanding of MHD flows. (AMR)

9316 ENERGY RELEASE BY MAGNETIC TEARING: THE NONLINEAR LIMIT. Van Hoven, Gerard; Cross, Mark A. (Department of Physics, University of California, Irvine, California 92664). Phys. Rev. A 7: No. 4, 1347-1352 (Apr 1973).

The nonlinear limit of the resistive tearing-mode instability is investigated by a time-dependent solution of the Fourier-transformed magnetohydrodynamic equations. The calculation is started with the fastest-growing linear mode and assumes a constant (e.g., turbulent) resistivity. Attainable magnetic Reynolds numbers are limited by the steep spatial gradients developed and by the propagation of Alfvén waves in the system. At the largest values used, 10% of the background energy is released in nonthermal forms. The time and energy scales found are consistent with the results of astrophysical observations and laboratory studies of solar-flare processes. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 8274, 8853, and 9394.

Electromagnetic

9317 (DESY-72/31) MEASUREMENTS OF INCLUSIVE HADRON MOMENTUM DISTRIBUTIONS IN DEEP INELASTIC ELECTROPRODUCTION. Alder, J. C.; Brasse, F. W.; Chazelas, E.; Fehrenbach, W.; Flauger, W.; Frank, K. H.; Ganssauge, E.; Gayler, J.; Korbel, V.; Krechlok, W. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jun 1972. 15p. INIS.

In the deep inelastic region of electron-proton scattering the distribution of hadrons in the direction of the virtual photon was investigated. At $q^2 = 1.16$ GeV^2 and W = 2.63 GeV coincidence measurements between the scattered electron and proton, $\pi^{\pm}$ and $K^{\pm}$ were made. Momentum and missing mass distribution are presented. They are compared with other electroproduction measurements, with photoproduction, and with hadronic reactions. (auth)

9318 METHOD OF INVESTIGATING RESONANCES THAT DECAY INTO A CHARGED PARTICLE AND A NEUTRAL PION OR η MESON. Anokhin, M. V.; Arakelyan, S. G.; Zverev, A. M.; Kanetsyan, A. R.; Nikitin, N. I.; Kharitonov, V. M.; Kheifets, S. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 4, 1018-1021 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 4, 46-48(1972).

A procedure is discussed for the experimental investigation of reactions of the $a + b \rightarrow b^* + X + \Sigma c_i$ type in the case when the α-particles of the primary beam have a broad energy spectrum and the resonance X decays according to the scheme $X \rightarrow m_{\pm} + \pi^0, \eta^0$. It is shown that it is sufficient to measure the momentum $\hookrightarrow 2\gamma$ and emission angle of the charged particle, $m_{\pm}$, and the momentum and emission angle of one of the photons from the decay of the $\pi^0(\eta^0)$ meson. In handling the information obtained it is the practice to use selection according to the energy sum of the recorded particles. The method ensures a large aperture ratio of the experimental installation. (auth)

9319 INELASTIC ELECTRON SCATTERING FROM HYDROGEN AND COMPLEX NUCLEI AT LARGE MOMENTUM TRANSFER. Andrews, D. E. Ithaca, NY; Cornell Univ. (1972). 172p. University Microfilms Order No. 73-5845.

Thesis (Ph. D.).

Single arm inelastic electron scattering spectra at incident energies from 4 to 10 GeV were obtained using an extracted electron beam from the Cornell 10 GeV electron synchrotron incident on liquid hydrogen, carbon, copper, and tantalum targets. Electrons scattered at angles of 6.5, 8.9, and 11.0° with momenta from the kinematic maximum of elastic electron nucleon scattering to below 3 GeV were momentum analyzed with the 10 GeV/c magnetic spectrometer. Elastic electron proton scattering was used to calibrate the spectrometer against the synchrotron energy. The results for radiatively corrected elastic electron proton differential cross sections are in agreement with data taken at other laboratories. Cross sections for the excitation of the nucleon resonances were extracted from the hydrogen data for absolute values of the photon mass squared q^2 below 2 GeV^2. The results are compared with an N/D model, a harmonic oscillator quark model, and the data of the MIT-SLAC collaboration. For values of the hadron center-of-mass energy W > 2 GeV, and the Bloom-Gilman scaling variables $\omega' = 1 + (W^2/q^2) > 5$, the inelastic structure functions are found to be primarily a function of q^2 alone with a weak dependence on the virtual photon energy ν similar to that of photoproduction. Where directly comparable, the electron proton cross sections agree with the MIT-SLAC results to 5%, an estimate of the systematic error in both experiments. A search for shadowing in inelastic electron scattering from complex nuclei showed disagreement with the predictions of vector meson dominance, and agreement with the SLAC result that shadowing is absent for $q^2 > 0.3$ GeV^2. (Diss. Abstr. Int., B)

9320 MEASUREMENT OF RHO MESON AND PI MESON CONTINUUM ELECTROPRODUCTION. Lazarus, E. Ithaca, NY; Cornell Univ. (1972). 166p. University Microfilms Order No. 73-7138.

Thesis (Ph. D.).

The reactions $e^- + p \rightarrow e^- + p + X^0$ and $e^- + p \rightarrow e^- + \pi^+ + X^0$, where X^0 is some neutral state, were observed simultaneously by detecting the coincidence of the electron and the positively charged hadron. Measurements were made at values of $Q^2 = 0.3$, 0.6, and 1.2 GeV^2, with W, the total energy in the virtual photon-proton center of mass, held constant at 3 GeV. The missing mass of the neutral system was computed from the momenta and angles of the final state electron and hadron. For the data in which the proton was detected, the missing mass distribution was studied both in the region of the ρ^0 meson and for higher masses, $0.875 \text{ GeV}^2 < M_X^2 < 1.875 \text{ GeV}^2$. Great difficulty was encountered attempting to extract the ρ^0 out of the background for the calculation of the t distribution. The total ρ^0 yield, however, was found to fall more rapidly with Q^2 than the total virtual photoabsorption cross section. For the highmass data, the slopes of the t distributions were consistently in the range of b = 2.0 to 2.5 GeV^{-2} independent of Q^2, although the total yield of these masses followed the Q^2 dependence of the total photoabsorption cross section. The pion data in the restricted region of phase space were found to be consistent with a measurement made using real photons. Also, the partial multiplicity of pions in the restricted aperture was independent of Q^2. (Diss. Abstr. Int., B)

9321 PHOTOPRODUCTION OF ETA MESONS AT 4 AND 8 GeV. Ritchie, D. J. Ithaca, NY; Cornell Univ. (1972). 180p. University Microfilms Order No. 73-5862.

Thesis (Ph. D.).

An experiment was performed at the Wilson Synchrontron Laboratory to measure the photoproduction of eta mesons (548 MeV), $\gamma + p \rightarrow \eta + p$ at incident photon energies of 4 and 8 GeV and momentum transfers from -0.3 (GeV/c)^2 to -0.8 (GeV/c)^2. The process was identified by detecting the two decay photons from the eta in coincidence with the recoil proton. The resulting cross sections are presented and are compared with previous measurements of the process and with certain theories making predictions for the resulting cross sections. (Diss. Abstr. Int., B)

9322 EXPERIMENTAL VERIFICATION OF THE KRAMERS-KRONIG RELATION AT HIGH ENERGY. Alvensleben, H.; Becker, U.; Biggs, P. J.; Busza, W.; Chen, M.; (and others) (Deutsches Elektronen-Synchrotron DESY, Hamburg, Germany). Phys. Rev. Lett. 30: No. 8, 328-332 (19 Feb 1973).

The real part of the forward amplitude for Compton scattering on protons was measured through the interference between the Compton and Bethe-Heithler amplitudes by detecting the zero-degree electron pairs asymmetrically. The measurement was made at an average photon energy of $\langle k \rangle = 2.2$ GeV, and an average momentum transfer to the recoil proton $\langle t \rangle = -0.027$ (GeV/c)^2. The result confirms the prediction of the Kramers-Kronig relation. (auth)

9323 MEASUREMENT OF $\pi^+\pi^-$ AND $\pi^0\pi^0$ PHOTOPRODUCTION DIFFERENTIAL CROSS SECTIONS FOR INCIDENT γ-RAY ENERGIES FROM 600 TO 900 MeV. Beneventano, M.; d'Angelo, S.; de Notaristefani, F.; Monacelli, P.; Paoluzi, L.; Persi, P.; Sebastiani, F.; Severi, M. (Univ., Rome). Nuovo Cim.; 15A: No. 3, 449-466(1 Jun 1973).

Cross sections of the reactions $\gamma + p \rightarrow p + \pi^+ + \pi^-$ and $\gamma + p \rightarrow p + \pi^0 + \pi^0$ were measured at the 1.1 GeV Frascati electrosynchrotron for photon energies E_γ between 600 and 900 MeV, for five proton momenta and at fixed proton laboratory angle $\theta_p = 32°$. The cross sections of $\pi^+\pi^-$ photoproduction exhibit behaviors in agreement with the Δ^{++} production; no immediate evidence is found of contribution of $\pi\pi$ interactions. The mean value of the ratio $\pi^+\pi^-/\pi^0\pi^0$ is 2.7 ± 0.3. (auth)

Weak

9324 STUDY OF THE REACTION $\nu p \rightarrow \mu^- \pi^+ p$. Campbell, J.; Charlton, G.; Cho, Y.; Derrick, M.; Engelmann, R. (Argonne National Lab., IL). Phys. Rev. Lett.; 30: No. 8, 335-339(19 Feb 1973).

We present an analysis of 153 events of the reaction $\nu p \rightarrow \mu^- \pi^+ p$ at an average neutrino energy of 1 GeV. The results were obtained using the Argonne 12-ft hydrogen bubble chamber. The reaction is dominated by $\mu^- \Delta^{++}(1236)$ production for which the total cross section rises from threshold to a value of $(0.74 \pm 0.18) \times 10^{-38}$ cm^2 at $E\nu \gtrsim 1.0$ GeV. The production and decay angular distributions of the Δ^{++} are given. There is no evidence for hadron–lepton mass enhancements. (auth)

Strong (Baryon-induced)

Refer also to abstract 9527.

9325 (JINR-P1-6993) SLOPE PARAMETER AND THE REAL PART OF THE p-n ELASTIC SCATTERING AMPLITUDE

IN THE ENERGY RANGE OF 10 TO 70 GeV. Beznogikh, G. G.; Bujak, A.; Zhidkov, N. K.; Zayachki, V. I.; Zolin, L. S.; Kirillova, L. F.; Nikitin, V. A.; Sviridov, V. A.; Truong Bien; Shfranova, M. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Based on the experiments on studying the elastic p-d and p-p scattering at small angles, carried out at the Serpukhov accelerator, the slope parameter for the differential elastic p-n cross section and the value of a_{pn} (ratio of the real part of the elastic p-n scattering amplitude to its imaginary part) are determined using the Glauber model. (auth)

9326 (JINR-P1-7004) DEUTERON NUCLEAR FORM FACTOR FROM THE EXPERIMENTAL DATA ON THE p–d SMALL ANGLE ELASTIC SCATTERING AND DATA ON THE ELECTROMAGNETIC DEUTERON FORM FACTOR. Zolin, L. S.; Nikitin, V. A.; Truong Bien; Shafranova, M. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The deuteron form factor was determined from the experimental data on the p-d elastic scattering in the energy range of 10 to 26 GeV based on the Glauber theory. Out of the considered wave functions the Brussel and Kerman wave function gives the best agreement with the experiment. The data obtained agree with the experimental results on the e-d scattering. (auth)

9327 (LYCEN-7268) FINAL STATE n–p INTERACTION IN $^2H(d,pn)^2H$, $^4He(d,pn)^4He$, $^6Li(d,pn)^6Li$, AND $^3He(d,pn)^3He$ REACTIONS. Chemarin, M.; Burq, J. P.; Cabrillat, J. C.; Ille, B. (Lyon Univ. (France). Institut de Physique Nucleaire). Nov 1972. 21p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Three body break-up in n–p final state interaction regions was investigated using the reactions $^2H + d \rightarrow p + n + {}^2H$; $^4He + d \rightarrow p + n + {}^4He$, $^6Li + d \rightarrow p + n + {}^6Li$, $^3He + d \rightarrow p + n + {}^3He$. In all cases, the proton and the neutron were detected at the same angle in a kinematically complete experiment for a deuteron bombarding energy of 27.5 MeV. Helium and deuterium gas targets in a small gas cell cooled with liquid-nitrogen were used. No indication of some possible contribution from the (isospin forbidden) $^1S_0$ proton-neutron final-state interaction was observed in the first three reactions. For the $^3He + d$ reaction, the data show pronounced enhancements due to the p–n final state interaction. In the forward regions the observed peaks are broader than the predictions of final state interaction models. (France)

9328 AMOUNT OF DIFFRACTION DISSOCIATION IN PROTON - PROTON SCATTERING AT 24 GeV/c. Pirila, P.; Ruuskanen, P. V. (CERN, Geneva). Nuovo Cim.; 15A: No. 1, 77-91(1 May 1973).

The amount of diffractive single and double dissociation in proton–proton scattering at 24 GeV/c is estimated in the context of the factorizable diffraction excitation mode. It is found that a realistic estimate for the maximal diffractive contribution is ⅓ of the total inelastic cross section. The study of inclusive pion spectra shows that the possible early scaling cannot be attributed to production through diffractive excitations in any region of the phase space. (auth)

9329 ANTIPROTON DEUTERON INTERACTIONS FROM 1.60 to 2.90 GeV/c. Eastman, P. S. East Lansing, MI; Michigan State Univ. (1972). 146 p. University Microfilms Order No. 73-12,702.

Thesis (Ph. D.).

In a bubble chamber experiment, the cross sections for zero- and two- through eight-prong topologies, along with the reaction cross sections within the two through six prong topologies for antiproton momenta from 1.60 to 2.90 GeV/c were determined. Resonance production cross sections in antiproton-neutron multipion annihilations for multiplicities of three through six pions and their angular and momentum distributions are presented with comparisons of the predictions of a multiperipheral model and a statistical model. Particular emphasis was given to investigating the isospin-one structure at center-of-mass energy of 2350 MeV derived from the total cross section measurements of antiproton-proton and antiproton deuteron interactions. The momentum to momentum dependence of the cross sections shows a possible enhancement in the ω production channels from the four and six pion annihilations, however further data at lower energies are necessary to confirm this enhancement. (Diss. Abstr. Int., B)

9330 NEGATIVE PARTICLE PRODUCTION OF THE FRAGMENTATION REGION AT THE CERN ISR. CHLM Collaboration. Nucl. Phys.; B56: No. 2, 333-345(1973).

Data are reported on the production of π^-, K^- and $\bar{p}$ in proton–proton collisions at the CERN ISR. Measurements were made at fixed c. m. angles in the range $(x,p_T) = (0.12, 0.16\ GeV/c)$ to $(x,p_T) = (0.82, 1.1\ GeV/c)$, over a range of squared c. m. energy $558 < s < 3950\ GeV^2$. Within this range Feynman scaling is a good description of the data for all particles. The approach to scaling is discussed. (auth)

Strong (Meson-induced)

9331 (JINR-E2-6978) PRODUCTION OF CHARGED PARTICLES IN INTERACTIONS OF π^- MESONS WITH LIGHT NUCLEI AT HIGH ENERGIES. Eliseev, S. M.; Grishin, V. G.; Inogamov, Sh. V.; Kohli, J. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The multiplicity distributions are investigated in the interactions of π^- mesons with light nuclei. The calculations were performed on the basis of intranuclear cascade model by the Monte-Carlo method. The theoretical results were compared with data obtained from a 2-meter propane bubble chamber of JINR at 40 GeV and emulsion data at 17.2 GeV. (auth)

9332 EXPERIMENTAL STUDY OF INCLUSIVE REACTIONS PRODUCED IN π^-p COLLISIONS AT 11.2 GeV/c. Borzatta, P. (Univ., Milan); Liotta, L.; Ratti, S.; Daronian, P.; Daudin, A. Nuovo Cim.; 15A: No. 1, 45-60(1 May 1973).

An experimental analysis of the inclusive reactions (1) $\pi^-p \rightarrow \pi^- +$ anything, (2) $\pi^-p \rightarrow p +$ anything, (3) $\pi^-p \rightarrow \pi^+ +$ anything, (4) $\pi^-p \rightarrow \rho^0 +$ anything, (5) $\pi^-p \rightarrow \Delta^{++} +$ anything is presented at 11.2 GeV/c. All invariant single-particle spectra normalized to the total cross section are studied as functions of Feynman's x and transverse-momentum squared. For the reactions (1), (2), and (3) the contributions of different topologies (2-, 4-, 6-, 8-prong events) in the limiting fragmentation regions are also shown. A comparison is performed between the reactions (4), (5), where diffractionlike processes are not allowed, and the corresponding reactions (1), (2) with "leading" particle effect. The average multiplicity for each detected particle is also calculated. (auth)

9333 PROPERTIES OF THE B-MESON OBSERVED IN 11 GeV/c π^+p INTERACTIONS. Afzal, M. (Univ. of Durham, Eng.); Evans, D.; Neat, K. P.; Caso, C.; Conte, F.; Trevisan, U.; Bassler, E.; Nagel, H.; Schlatter, W. D.; Soeding, P. Nuovo Cim.; 15A: No. 1, 61-76(1 May 1973).

Production and decay properties of the B-meson are studied in the reactions $\pi^+p \rightarrow B^+p$ at 11 GeV/c. Values for mass, width, total and differential cross sections and spin density matrix elements are given. The spin and parity, and the helicity states in the $B \rightarrow \pi\omega$ decay, are analysed. (auth)

9334 STUDY OF THE $\pi^-p\bar{K}^0$, $\pi^-\pi^+n\bar{K}^0$, AND $\pi^-p\pi^0\bar{K}^0$ FINAL STATES FROM K^-p INTERACTIONS AT 2.9 GeV/c. Khoury, B. V. College Park, MD; Univ. of Maryland (1972). 112p. University Microfilms Order No. 73-11,394.

Thesis (Ph. D.).

The final states $\pi^-p\bar{K}^0$, $\pi^-\pi^+n\bar{K}^0$, and $\pi^-p\pi^0\bar{K}^0$ resulting from K^-p interactions at an incident beam momentum of 2.87 GeV/c are analyzed. The data constitute part of the study of about one million pictures taken at the 31" bubble chamber at Brookhaven National Laboratory. This experiment represents the collaborative efforts of Brandeis, Maryland, Syracuse, and Tufts Universities. There is a very large sample of K*(890) mesons produced in each of the final states. The production and decay characteristics of this resonance are presented and are consistent with previously published results. A lesser amount of the K*(1400) is observed and its properties are also considered. The spin space density matrix elements for each of these meson resonances are presented as a function of four-momentum transfer squared. Amounts of each of the resonances present in these three final states are found along with their production and decay characteristics. (Diss. Abstr. Int., B)

9335 MEASUREMENT OF POLARIZATION IN $\pi^-P \rightarrow \pi^0N$ AT 3.5 AND 5.0 GEV/C. Hill, D.; Koehler, P.; Novey, T.; Rynes, P.; Sandler, B.; (and others) (Argonne National Laboratory, Argonne, Illinois 60439). Phys. Rev. Lett. 30: No. 6, 239-242 (5 Feb 1973).

The polarization parameter P(t) for the reaction $\pi^-p \rightarrow \pi^0n$ has been measured at 3.5 and 5.0 GeV/c over the range $0.2 \leq -t \leq 1.8$ $(GeV/c)^2$. The two γ rays from the π^0 decay were detected in a large lead-glass hodoscope. The results agree with the positive polarization values found in earlier Argonne National Laboratory data at $-t < 0.35$ $(GeV/c)^2$. P(t) drops to a small value near $t = -0.6$ $(GeV/c)^2$ and remains the same out to $t = -1.8$ $(GeV/c)^2$. (auth)

9336 NEW CHARGE-EXCHANGE POLARIZATION DATA AND πN-AMPLITUDE ANALYSES AT 3.6 AND 6.0 GEV/C. Johnson, P. (Illinois Institute of Technology, Chicago, Illinois 60616);

Lassila, K. E.; Koehler, P.; Miller, R.; Yokosawa, A. Phys. Rev. Lett. 30: No. 6, 242-245 (5 Feb 1973).

Using the results of recent πN charge-exchange polarization measurements at Argonne National Laboratory we have determined the amplitudes for πN scattering 3.6 and 6.0 GeV/c. Two different methods, individual t-by-t analysis and t-dependent analysis have been adopted, and uncertainties of these amplitudes are discussed. (auth)

9337 SEARCH FOR NARROW STRUCTURE IN THE S,T,U REGION. Bowen, D.; Earles, D.; Faissler, W.; Garelick, D.; Gettner, M.; (and others) (Northeastern University at Boston, Boston, Massachusetts 02115). Phys. Rev. Lett. 30: No. 8, 332-335 (19 Feb 1973).

We report a measurement of the missing mass (MM) spectra from the reaction $\pi^- + p - (MM)^- + p$ at 11, 13.4, and 16 GeV, in the region of the S(1930), T(2200), and U(2375) mesons. Our mass spectra exhibit no narrow enhancements in this region with $<d\sigma/dt> * 10 \mu b/GeV^2$. (auth)

9338 NON-DIFFRACTIVE PRODUCTION OF MESON RESONANCES. Fox, G. C.; Hey, A. J. G. (California Inst. of Tech., Pasadena). Nucl. Phys.; B56: No. 2, 386-439(1973).

The peripheral cross sections of resonances that cannot be produced by π-exchange are studied. In particular, the four meson nonets expected as L = 1 quark states (i.e., the $J^P = 0^+ \pi_N(980)$; $J^P = 1^+ A_1$, B; $J^P = 2^+ A_2$) are considered. SU(3), Regge poles, factorization, exchange degeneracy, pole extrapolation, and the vector-meson-photon analogy are used. The cross sections in both photoproduction and non-diffractive hadronic reactions are predicted. In passing, the large unnatural-parity (B, $K - Q_B$) exchange contributions and even the possibility of studying $\pi\pi \rightarrow \pi\omega$ while avoiding the B production background are discussed. (auth)

9339 DIFFERENTIAL CROSS SECTIONS FOR K^+n ELASTIC SCATTERING BETWEEN 0.64 AND 1.51 GeV/c. BGRT Collaboration. Nucl. Phys.; B56: No. 2, 346-355(1973).

Experimental results on the $K^+n \rightarrow K^+n$ differential cross sections measured in deuterium at 13 momenta between 0.64 and 1.51 GeV/c are presented. (auth)

9340 POLARIZATION IN BACKWARD ELASTIC π^+p SCATTERING AT 2.0, 3.5, AND 4.0 GeV/c. Bradamante, F.; Conetti, S.; Daum, C.; Fidecaro, G.; Fidecaro, M.; Giorgi, M.; Kalmus, G.; Penzo, A.; Piemontese, L.; Schiavon, P.; Stairs, D.; Vascotto, A. (CERN, Geneva). Nucl. Phys.; B56: No. 2, 356-380(1973).

Data on polarization in backward elastic π^+p scattering at 2.0, 3.5 and 4.0 GeV/c are presented. The data at 2.0 GeV/c are compared with the result of a recent phase-shift analysis. Our data at 3.5 and 4.0 GeV/c, and existing data above 3 GeV/c, show no significant energy dependence of the polarization over the measured u-range. A comparison with Regge models and with results from amplitude analysis is made. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 9699.

9341 (JINR-P1-7062) ESTIMATE OF THE HISTOGRAM DISTRIBUTION PARAMETERS. Berezhnev, S. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The estimates are compared obtained by the least square method, by χ^2 minimum and by maximum likelihood methods. It is shown that the estimates obtained by the least square method are shifted with respect to the maximum likelihood estimates much more than those obtained by the χ^2 minimum method. A square functional is suggested allowing one to get estimates coinciding with those obtained by the maximum likelihood method. (auth)

9342 (JINR-P2-7032) ASYMPTOTIC RELATIONS BETWEEN THE STRUCTURE FUNCTIONS IN INCLUSIVE PROCESSES FOR PARTICLES RELATED TO ONE ISOMULTIPLET. Grishin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 9p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Relations between the structure functions are considered for particles, related to one isomultiplet. (auth)

9343 DERIVATION OF A PARTON MODEL SUM RULE WITHIN THE FRAMEWORK OF DASHEN-GELL-MANN'S PROGRAM. Pavkovic, M. L. (New York Univ., NY). Nuovo Cim.; 15A: No. 1, 127-135(1 May 1973).

The sum rule $\int_1^\infty (\nu W_2/\omega) d\omega = \Sigma_{N=1}^\infty P(N) \langle \Sigma_{\alpha=1}^N e_\alpha^2 \rangle_N$ is derived within the framework of Dashen-Gell-Mann's program, under mild technical assumptions concerning the existence of the infinite-momentum limit. The derivation is consistently relativistic and mathematically exact. (auth)

9344 CUT CONTRIBUTIONS IN THE TRIPLE-POMERON LIMIT. Cardy, J. L. (CERN, Geneva). Nucl. Phys.; B56: No. 2, 605-612(1973).

Pomeron cut contributions in the triple-pomeron limit of one-particle inclusive cross sections are investigated near t = 0 where the triple-pole coupling vanishes. It is found that at t = 0 the cuts themselves are suppressed, contributing factors $(\ln M^2)^{-2}$, rather than the single logarithms characteristic of cut contributions in two-body processes. A simple reggeon calculus model is constructed in which all important cuts near t = 0 can be calculated, and a simple way of parametrizing the data in that region is suggested. (auth)

9345 ELEMENTARY LENGTH AND MOESSBAUER EFFECT. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 4, 830-836(Apr 1973). (In Russian).

It is shown that the Moessbauer effect is not critical for estimate of the "elementary length." (auth)

9346 REMARK ON THE RAPIDITY DISTRIBUTION OF THE FRAGMENTATION MODEL NEAR Y = 0. Glen, T. T. (State Univ. of New York, Stony Brook). Lett. Nuovo Cim.; 7: No. 2, 49-52(12 May 1973).

The rapidity distribution functions obtained in the Quigg, Wang, and Yang model (Phys. Rev. Lett., 28, 1290(1972)) were found to disagree qualitatively with preliminary results of a recent experiment that show a translational invariance at small y in the rapidity distribution $d\sigma/dy$. It is pointed out that this disagreement is expectable because in the QWY model, which was constructed within the fragmentation picture, only particles produced in high-energy collisions with their rapidity greater than a certain finite quantity are considered. (LBS)

9347 PARASTATISTICS AND CLUSTER PROPERTY. Thien Vo-Dai (Univ. of Montreal). Lett. Nuovo Cim.; 7: No. 3, 108-112(19 May 1983).

The symmetrization postulate states that the wave functions of N identical particles are either symmetric or antisymmetric in the particle variables. An argument put forth by Steinmann (Nuovo Cimento 44A: 755(1966)) based on the cluster property to prove the symmetrization postulate received some opposition. An attempt is made to clarify some errors in the criticism against Steinmann's argument and to formulate the argument more rigorously and more unambiguously. (LBS)

9348 UNSTABLE-PARTICLE THEORY. Hittner, D. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo Cim.; 15A: No. 3, 401-429(1 Jun 1973).

Some problems in the representation of highly unstable particles (resonances) are considered: the usual way of relating a pole of the S-matrix (or field propagator) to each particle is shown not to have quite obvious physical foundations in the case of stable particles; in particular, examples of resonant scattering amplitude and propagator are given explicitly. Another more straightforward way of representing an unstable particle is to describe its continuous mass distribution by means of the spectral function of its field, as was first proposed by Matthews and Salam. Here, these authors' interpretation of the spectral function is tested and confirmed on the example of the multiple Lee model. But a new definition of the mass and width of the particle has to be proposed in order to rule out some difficulties raised by that of Matthews and Salam. On the other hand, for unstable particles the problem of the correspondence between particles and fields, solved in the case of stable particles (asymptotic field theory), is no longer trivial, and has to be reconsidered. This involves a physical interpretation of renormalization related to the splitting of the spectral function of a field into a peak connected to an unstable particle and a nonresonant background. (auth)

Electromagnetic

Refer also to abstracts 9119 and 9926.

9349 (JINR-E2-6982) ELECTROMAGNETIC PION RADIUS COMING FROM π^+ ^{4}He SCATTERING. Nichitiu, F.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The influence of ambiguity in phase shift analysis, of the total cross section and the beam energy on the electromagnetic pion radius, derived from π^+ ^{4}He elastic scattering measurements, is

analyzed. It is shown that the pion radius obtained from existing experiments is $\langle r_\pi^2 \rangle^{1/2} = 0.80 \pm 0.40$ fm. (auth))

9350 (JINR-E2-7028) ELECTROMAGNETIC MASS DIFFERENCES OF NUCLEONS AND SUM RULES IN THE AUTOMODEL REGION. Magradze, B. A.; Matveev, V. A.; Tavkhelidze, A. N.; Robaschik, D.; Wieczorek, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The electromagnetic mass corrections for nucleons are considered in connection with deep inelastic scattering. Using a Dyson–Jost–Lehmann representation for the virtual Compton scattering amplitude conditions for the finiteness of δ^m are given in terms of sum rules for the structure functions in the automodel region. (auth)

9351 (JINR-E2-7051) AUTOMODEL BEHAVIOUR OF THE VIRTUAL COMPTON SCATTERING AMPLITUDE IN THE FRAMEWORK OF THE DYSON–JOST–LEHMANN REPRESENTATION. Matveev, V. A.; Robaschik, D.; Wieczorek, E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

Using a DJL representation for the one particle matrix elements of the T-product of currents the automodel behavior of the virtual Compton scattering amplitude is studied. Logarithmic terms in the real part, which occur in general, vanish because of the kinematical constraints in the case of Compton scattering. It is observed that the real part of the scattering amplitude gives more information on the lead light cone singularity than the imaginary part. (auth)

9352 (ORO-3992-123) STATIONARY STATES OF A SPIN-1 PARTICLE IN A HOMOGENEOUS MAGNETIC FIELD. Mathews, P. M. (Texas Univ., Austin. Center for Particle Theory). May 1973. 20p. (CPT-73). Dep. NTIS $3.00.

A simple and complete determination of the energy spectrum and eigenfunctions of a relativistic spin-1 particle with arbitrary magnetic moment in a homogeneous magnetic field. The particle is described by a four-vector field satisfying the usual second order equation including anomalous magnetic moment interaction. In the light of these results and those pertaining to the case when the external field is a Coulomb field, the question of consistency of the vector theory at the basic c-number level is briefly discussed. (auth)

9353 (ORO-3992-126) FORWARD PEAKED ν_e-e SCATTERING AND THE SOLAR NEUTRINO PROBLEM. Clark, R. B.; Pedigo, R. D. (Texas Univ., Austin. Center for Particle Theory). Apr 1973. Contract AT(40-1)-3992. 10p. (CPT-178). Dep. NTIS $3.00.

The possibility that multiple ν_e-e scattering within the sun can account for the low solar neutrino counting rates is considered. In the absence of ν_e-e scattering data, bounds are imposed from ν_e-e data, introducing a requirement for strong forward peaking. Generalized four-fermion interactions calculated to first order are found to be inadequate. Electromagnetic ν_e-e interactions with a finite neutrino magnetic moment are found to be satisfactory, but require a seemingly unphysical neutrino form factor corresponding to a mean neutrino radius of $\bar{r}_\nu > 10^{-10}$ cm. (auth)

9354 (RLO-2230-T-4-87) PION CHARGE RADIUS FROM CURRENT ALGEBRA SUM RULE AND SHORT RANGE CORRELATION MODEL. Aubrecht, G. J. II; Hwa, R. C. (Oregon Univ., Eugene. Inst. of Theoretical Science). 19 Mar 1973. Contract AT(45-1)-2230. 8p. Dep. NTIS $3.00.

Starting from the Fubini–Dashen–Gell–Mann sum rule, the slope of the pion electromagnetic form factor at t = 0 is related to the rotational properties of the photopion production amplitudes. When the pion's charge radius is calculated with a simple short range correlation model for the production amplitudes (diffractive processes being forbidden), the results is $\langle r_\pi^2 \rangle^{1/2} = 0.8F$. (auth)

9355 PHENOMENOLOGICAL COMPARISON OF ep AND pp INELASTIC SCATTERING. Kuroda, M. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6, 1918-1922(Dec 1972).

Comparison between ep and pp inelastic scattering is performed phenomenologically. It is found that in fairly large t region, the t dependence shows the similar behavior for ep and pp inelastic scattering. (auth)

9356 BJORKEN LIMIT OF BINCER'S FORM FACTOR AND THE RENORMALIZATION CONSTANT OF THE PROTON. Hirayama, M.; Ishida, J. (Toyama Univ., Japan). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2377-2390(Dec 1972).

The Bjorken limit of Bincer's form factor is investigated and applied to the exploration of the value of the wave function renormalization constant, Z_2, of the proton. It is shown that the Bjorken limit of Bincer's form factor takes quite a simple form if Z_2 is non-vanishing. Through the analysis on the consistency of non-vanishing Z_2 with Bjorken's scaling hypothesis on electromagnetic structure functions, the following is concluded: Z_2 should vanish if the Bjorken limit of $\nu W_2(\nu, q^2)$, $J_2(\omega)$, is smooth around $\omega = 1$ and the product $J_2(\omega)\sigma_L/\sigma_T$ appropriately vanishes at $\omega = \infty$. (auth)

9357 MESON PHOTOPRODUCTION IN THE STATISTICAL APPROACH TO DUAL HADRODYNAMICS. Application to ρ^0 Photoproduction. Hacinliyan, A.; Maheshwari, A. (International Centre for Theoretical Physics, Trieste, Italy). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2283-2300(Dec 1972).

The application of the dual theory of hadron electromagnetic currents to meson photoproduction is studied. The "statistical approximation" of Chang, Freund and Nambu to the dual resonance model is used for calculating the Born approximation Feynman graphs. A technique for constructing gauge-invariant amplitudes in the limit of statistical approximation to the dual amplitudes is developed. It is found that the vector-meson photoproduction amplitude in this model has similar properties to those of the vector-meson dominance model based on the photon vector analogy. The model developed is applied to data of the process $\gamma p \to \rho^0 p$. The fit to ρ photoproduction differential cross section allows an estimate to be made of the charge distribution weight function of the dual hadrodynamics. (auth)

9358 GAUGE-INVARIANT QUANTUM ELECTRODYNAMICS WITH MASS CHANGING MINIMAL CURRENT. Namiki, M.; Yokoyama, K. (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2093-2105(Dec 1972).

A gauge invariant local electrodynamics with the mass-changing minimal current giving rise to excitation processes of baryon or lepton is exactly formulated by means of introducing two ghost gauge fields. It is shown that the whole S-matrix in this formalism is equivalent to that in the conventional formalism with the Feynman gauge and without the ghost fields. On the bases of these arguments, a possible form of phenomenological mass-changing current vertex function of nucleon is suggested. (auth)

9359 ASYMPTOTIC ESTIMATION OF FOURIER TRANSFORMS AND LIGHT CONE DOMINANCE. Chen, T. W. (Department of Physics, New Mexico State University, Las Cruces, New Mexico 88001). J. Math. Phys. (N.Y.) 14: No. 2, 287-291 (Feb 1973).

The usual method of asymptotic estimation of Fourier transforms, the phase oscillation method, is examined. It is found that the usual argument of phase oscillation can be misleading due to either locations of singularities or absolute integrability of functions. As a by-product we have found that the scaling law for the inelastic e-p scattering should also be valid as the energy change $\nu \to \infty$ regardless of the momentum transferred squared κ, according to the usual approach of light cone dominance. (auth)

9360 UNITARITY LOWER BOUND ON THE LONGITUDINAL CONTRIBUTION TO INELASTIC ELECTRON-PROTON SCATTERING. Sakurai, J. J. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 30: No. 6, 245-248 (5 Feb 1973).

The diffractive electroproduction of longitudinal ρ mesons sets, via unitarity and the Schwarz inequality, a lower bound to the longitudinal cross section in inelastic electron–proton scattering. Recent ρ electroproduction data may be used to infer that the longitudinal–to–transverse ratio R in total electroproduction at $\omega \simeq 16$, $q^2 \simeq 1$ GeV^2 is an order of magnitude greater than is predicted by models yielding $R = q^2/\nu^2 = (4m_N^2/q^2)\,\omega^{-2}$. (auth)

9361 CANONICAL APPROACH TO RADIATION DAMPING. Radin, R. J. Washington, DC; George Washington Univ. (1972). 173p. University Microfilms Order No. 73-4018.

Thesis (Ph. D.).

A Hamiltonian formalism leading to a perturbation solution of the Liouville equation was used to investigate the radiation damping problem of a classical charged particle in the gauge in which $A^\circ = 0$. The particle is allowed to interact with its self-field (both longitudinal and transverse) as well as a spatially homogeneous time-dependent external field. It is found that a direct integration and iteration of the Liouville equation using physically sensible initial conditions does not give rise to any radiation-reaction. However, suitable modification of the initial and final phase space density, which seems to correspond to the definition of asymptotic states in quantum electrodynamics, results in particle moment equations which exhibit radiation damping if only retarded fields are included, and antidamping if only advanced fields are included. Furthermore there is no radiation-reaction force on the particle, nor any apparent energy loss to radiation in the case of a time-

independent external force. There is no pre-acceleration or runaway character to the solution and it is strongly indicated that these phenomena occur in the usual formulation as a direct result of erroneously assuming analyticity of the space-time trajectory. (Diss. Abstr. Int., B)

9362 STUDY OF $K_{3\pi}$ AND $\eta_{3\pi}$ DECAYS IN GENERALIZED VENEZIANO MODEL. Mahajan, S. Lafayette, IN; Purdue Univ. (1972). 86p. University Microfilms Order No. 73-6060.

Thesis (Ph. D.).

The interaction Hamiltonians responsible for 3π decays of K through weak interactions and η through electromagnetic interactions are treated as fictitious particles called "spurions." The decay processes are then the same as scattering processes $K(\eta)$ + "spurion" $\rightarrow 3\pi$. The amplitudes for the latter are written down in the framework of the generalized Veneziano model and calculated numerically for various values of Dalitz variables. The theoretical decay spectra are compared with experimentally observed spectra. For all decays of K and $3\pi^0$ decay of η very good agreement between theory and experiment was obtained. However, in the $(\pi^+\pi^-\pi^0)$ decay mode of η, there is significant disagreement. The overall normalizations were determined from $(K^+ \rightarrow \pi^+\pi^-\pi^0)$ and $(\eta \rightarrow \pi^+\pi^-\pi^0)$ experimental decay rates. Using these one gets decay rates for other modes in good agreement with experiment. (Diss. Abstr. Int., B)

9363 SPATIAL COHERENCE OF THE FIELD OF SYNCHROTRON RADIATION OF RELATIVISTIC ELECTRONS. Mazmanishvili, A. S.; Uvarov, V. L. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 3, 283-285(Sep 1972).

Translated from Opt. Spektrosk.; 33: No. 3, 525-529(Sep 1972).

The spatial coherence of the field of synchrotron (magnetic bremsstrahlung) radiation of relativistic electrons was studied. The analysis was conducted by taking into account the finite aperture of the optical instruments used in the study of coherent phenomena of optical fields. On the basis of coherence functions obtained in explicit form, recommendations are made with regard to the observation of correlation optical phenomena through the use of synchrotron radiation. For purposes of comparison, the study was carried out for the field of synchrotron radiation as well as the field of equilibrium blackbody radiation. (auth)

9364 GENERAL MULTIPLE PRODUCTION LAW FROM 10 TO 10^{12} GeV. Capdevielle, J. N. (Observatoire du Pic du Midi, Bagneres-de-Bigorre, France); Cachon, A.; Dupuy, J. Compt. Rend., Ser. B; 276: No. 6, 219-222(5 Feb 1973). (In French).

A simulation method was used to study the average properties of extensive cosmic ray showers. The law concerning the multiplicity of secondary particles was obtained $M = 3E_0^{\frac{1}{4}}$. The range over which this law is valid (compatible with the results obtained above 10 GeV with accelerators) indicates that the law may be extended to cover the highest known energies. (France)

9365 ELECTROMAGNETIC MASS SHIFT OF HADRONS. Kunimasa, T. (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2391-2398(Dec 1972).

Based on the indicated possibility of the divergence of the electromagnetic mass shift of hadrons, a simple method of computing a finite value out of the divergent self-energy integral is proposed. The divergent self-energy integral is assumed to be given by bare-like contributions of one-particle intermediate states in the lowest-order self-energy diagrams. (auth)

9366 GREEN FUNCTION FOR A PARTICLE IN A UNIFORM ELECTRIC FIELD. Moyer, C. A. (Battelle Memorial Inst., Columbus, OH). J. Phys., C (London); 6: No. 9, 1461-1466(10 May 1973).

A closed form is presented for the one-dimensional Green function of a particle in a uniform electric field pervading all space. The Green function is found to be analytic in the whole complex energy plane; some interesting implications of this analyticity are discussed. Further analysis employing more realistic boundary conditions at infinity indicates, however, that no physical system (no matter how large) is adequately represented by the uniform field model for arbitrarily weak field intensities, though the limitation is of no practical importance. (auth)

9367 MOTION OF A CHARGED LIGHTLIKE PARTICLE IN AN EXTERNAL FIELD. Cawley, Robert G. (Naval Ordnance Laboratory, Silver Spring, Maryland 20910). J. Math. Phys. (N.Y.) 14: No. 3, 380-386 (Mar 1973).

We investigate the behavior of a charged photon in an external field, discussing the general theory and working out some examples. The mathematical basis for the equations of motion is a Stueckelberg action principle combined with a treatment which parallels that of Jacobi's principle. (auth)

9368 TWO-PHOTON EXCHANGE IN ELECTRON-DEUTERON SCATTERING. Gunion, J.; Stodolsky, Leo (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). Phys. Rev. Lett. 30: No. 8, 345-348 (19 Feb 1973).

We show that multiple scattering of the electron (i.e., two-photon exchange) in electron-deuteron elastic scattering leads to a small component in the cross section, which decreases very slowly with momentum transfer and may dominate the cross section at high momentum transfer. (auth)

9369 SOFT BREMSSTRAHLUNG STRUCTURE FUNCTION. Choudhury, S. R.; Rotelli, P. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Phys.; B56: No. 2, 589-596 (1973).

Low's theorem is used to express the soft-photon structure function in terms of the single- and double-charged particle structure functions. With the simplifying assumption that asymptotically the hadronic particles cluster (in the c. m. frame) in sharp forward and backward cones, a simple explicit form for this soft bremsstrahlung structure function is obtained. The question of scaling is discussed. (auth)

9370 DEEP-INELASTIC ONE-PARTICLE INCLUSIVE PROCESSES IN THE PARTON MODEL. Altarelli, G. (Univ., Rome); Maiani, L. Nucl. Phys.; B56: No. 2, 477-492(1973).

The processes $e + N \rightarrow e' + h$ + anything, $e^+ + e^- \rightarrow h$ + anything are studied within the parton model of Landshoff, Polkinghorne and Short. Definite and peculiar predictions are obtained, also common to the Drell, Levy and Yan cut-off theory and to the $\lambda\phi^3$ ladder model. These predictions can be summarized as follows: (i) in the photon fragmentation region the cross section factorizes after integration over transverse momentum of h; (ii) in the target fragmentation region Regge behavior, valid at large ω, gives rise to double Regge exchange for small values of the Feynman variable y, but only up to $y \simeq -1/\omega$; (iii) the structure functions vanish at $y = 0$; (iv) total multiplicities in the first process increase like $\ln \omega$ for large ω, and in the second reach a finite limit at large q^2. In the case where only one SU(3) multiplet of partons is present (as in the quark parton model) unique relations, valid in the limit of exact SU(3), are found between the cross section and multiplicities in the first process and the analogous quantities for the forward region of the second process. (auth)

9371 NEUTRAL WEAK CURRENTS AND THE PROTON-NEUTRON MASS DIFFERENCE. Love, A.; Ross, G. G. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys.; B56: No. 2, 440-444(1973).

The logarithmically divergent contributions to the proton-neutron mass difference arising from the exchange of intermediate vector bosons are investigated. Within the framework of Weinberg's model a divergent contribution of opposite sign to the electromagnetic divergence is found, which is, however, insufficient to cancel it completely. (auth)

9372 COULOMBIC SCATTERING OF POLARIZED SPIN-1 PARTICLES IN FIVE-DIMENSIONAL THEORY. Bedritskii, A. I. (Vitebsk Teachers Inst., USSR). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 5, 96-100(1972). (In Russian).

Discrete physical characteristics of particles and antiparticles $n = \pm 1$ give a spirality of particles and antiparticles relative to their character. On the basis of a set of five equations, simulating some form of gravitational interaction, accompanying electromagnetic, a solution was obtained for the problem of scattering polarized particles with a spin of 1 by a heavy Coulomb center. The cross section appeared unique for common (L) and R-particles, and also for particles and antiparticles. The $L \rightleftharpoons R$ transitions did not occur. There was eventually obtained a more complex angular dependence than for the corresponding cross sections in four-dimensional theory, but in nonrelativistic limits-Rutherford's formula. (tr-auth)

9373 APPLICATION OF FRITZSCH-GELL-MANN ALGEBRA TO THE DEEP INELASTIC PROCESSES $e + N \rightarrow e + \gamma +$ ANYTHING AND $\nu + N \rightarrow l + \gamma +$ ANYTHING. Murtaza, G.; Razmi, M. S. K. (Islamabad Univ., Pakistan). Progr. Theor. Phys. (Kyoto); 48: No. 6, 1960-1976(Dec 1972).

The processes $e + N \rightarrow e + \gamma +$ anything and $\nu + N \rightarrow l + \gamma +$ anything, where l is a charged lepton, are studied in generalized Bjorken limits of two types. In the kinematical regions considered, the light cone algebra of vector and axial-vector currents suggested by Fritzsch and Gell-Mann is applied. This leads to relations between the nonbremsstrahlung part of each process above and the corresponding process without the detection of the final state photon. These relations may be regarded as Ward identities for a hard photon. Finally, structure functions of the nonbremsstrahlung parts are found to scale. (auth)

9374 MODIFICATION OF THE ADLER–FUBINI SUM RULE. Mukherjee, S. (Himachal Pradesh Univ., Simla, India). Lett. Nuovo Cim.; 7: No. 4, 139-143(26 May 1973).

It is shown that a simple modification of the Adler–Fubini sum rule is consistent at least qualitatively with both the rapid convergence of the values for $\nu W_2^{ep} - \nu W_2^{en}$ and the measured scaling-limit values for νW_2^{ep}. The modification involves only a technical assumption, and no important postulate of current algebra is affected. (JFP)

9375 SCALING LAW FOR GENERAL REACTIONS INDUCED BY CURRENT. Fukuda, R. (Tokyo Univ.). Lett. Nuovo Cim.; 7: No. 2, 69-75(12 May 1973).

The general scaling law is discussed for electroproduction of hadrons in the target fragmentation region where an arbitrary number (n−1) of hadrons with masses m_i are detected. It is shown that a natural generalization of Bjorken's scaling rule in the prescribed limit leads to many relations involving Bjorken ω and Feynman x. (LBS)

9376 INCLUSIVE SUM RULES IN CURRENT-INDUCED HADRON PRODUCTION. Konishi, K. I. (Scuola Normale Superiore, Pisa, Italy). Lett. Nuovo Cim.; 7: No. 2, 53-59(12 May 1973).

Inclusive sum rules are written down for two types of reactions: 1) e^+e^- annihilation and 2) e p deep inelastic scattering. In 1) it is shown how the asymptotic behavior of the hadron multiplicity and that of the total annihilation cross section are related to each other by the sum rule under the hypothesis of scaling. In 2) it is shown that generalized scaling laws predicted from parton models and from light-cone arguments are consistent with the sum rules. A possible more general scaling law is suggested for the current fragments. (LBS)

9377 DEEP INELASTIC SCATTERING IN A FIELD THEORY WITH COMPUTABLE LARGE-MOMENTA BEHAVIOR. Parisi, G. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 7: No. 2, 84-88 (12 May 1973).

It is shown that in the $g\phi^4$ theory with a negative coupling constant the deep inelastic structure functions can be directly computed in the Bjorken limit. (LBS)

9378 TWO-PHOTON AND POSSIBLE WEAK INTERFERENCES IN e^+e^- ANNIHILATION. Gatto, R.; Preparata, G. (Univ., Rome). Lett. Nuovo Cim.; 7: No. 3, 89-97(19 May 1973).

A quantitative examination is made of the interference between two-photon and one-photon annihilations in the one-particle inclusive interactions, $e^+e^- \rightarrow$ hadron + anything, and the interference from a possible annihilation via weak neutral vector boson. Two-photon effects in the low-energy and resonance region and in the high-energy diffractive region are considered. The forward-backward asymmetry is calculated in a number of models. It is found that only at energies of the order of the vector-meson mass do the effects become observable. (LBS)

9379 SOME COMMENTS ON THE $\eta \rightarrow 3\pi$ PUZZLE. Hari Dass, N. D. (Univ. of California, Los Angeles); Madan, R. N. Lett. Nuovo Cim.; 7: No. 3, 117-120(19 May 1973).

The possible connection between the Adla anomalies in pion electrodynamics with the $\eta \rightarrow 3\pi$ decay is investigated. It is pointed out that the anomalous electromagnetic interactions of pions and photons do give qualitative insights into the decay. An explicit amplitude for $\eta \rightarrow 3\pi$ is constructed that satisfies the Adler consistency condition when smoothly extrapolated off mass shell and has the correct slope for the physical Dalitz plot. (LBS)

9380 INELASTIC ELECTRON–NUCLEON SCATTERING IN THE BJORKEN–PASCHOS PARTON MODEL. Layssac, J. (Departement de Physique Mathematique, Montpellier, France). Nuovo Cim.; 15A: No. 3, 467-480(1 Jun 1973).

It is shown that an acceptable fit of the deep inelastic electron–proton scattering can be obtained by using the Bjorken–Paschos parton model and particular mixings of quarks and gluons. The neutron–proton ratio is also fitted by using charge-symmetry relations. General features of a parton model for pions are given. (auth)

Weak

Refer also to abstract 9931.

9381 SOFT-PION LIMIT AND $K_{2\pi}$ DECAYS. Kikugawa, H. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6, 1977-1985 (Dec 1972).

The current algebra with the usual soft-pion limit has some problems in the calculation of hadronic decays: (i) the $K_{2\pi}$-decay amplitudes critically depend on which pion is assumed to be soft, (ii) the only intermediate states which can contribute to the pole terms must have the same masses as those of the initial and final particles. As a result the resonances do not give any contributions, (iii) the initial and final particles must have the same masses, i.e., $m_A = m_n$, $m_K = m_\pi$, etc. It is shown that these problems can be avoided if one takes the soft-pion limit in the rest frame of the pion. (auth)

9382 CONTRIBUTIONS OF SECOND-CLASS CURRENTS TO HYPERON DECAYS. Pietschmann, H. (Univ., Vienna); Stremnitzer, H.; Schroeder, U. E. Nuovo Cim.; 15A: No. 1, 21-37 (1 May 1973).

Recent measurements of the electron asymmetry of Σ^-n beta-decay and that of $e\nu$ correlation and asymmetries of Λp decay are analysed including pseudotensor and q^2-dependent form factors. The result is compared with Wilkinson's measurement of pseudotensor contributions in beta-decay of mirror nuclei, assuming some SU_3 structure of a second-class current. Possible consequences of octet and decuplet representations of the second-class axial vector current are discussed. (auth)

9383 $\nu p \rightarrow \mu^- \Delta^{++}$: COMPARISON WITH THEORY. Schreiner, P. A.; von Hippel, F. (Argonne National Lab., IL). Phys. Rev. Lett.; 30: No. 8, 339-342(19 Feb 1973).

New data on the reaction $\nu p \rightarrow \mu^- \Delta^{++}$ are compared with theoretical predictions. We stress the importance of the Δ spin-density matrix in making decisive tests of the models. The data are consistent with the prediction using partially conserved axial-vector currents for $d\sigma/dq^2$ near $q^2 = 0$. In contrast to previous findings, Adler's relativistic version of the static model is reasonably successful in fitting the data. Zucker's model also fits the data. (auth)

Strong (General)

9384 (COO–3227-31) IMPACT PICTURE OF pp, $\bar{p}p$, $\pi^\pm p$, AND $K^\pm p$ ELASTIC SCATTERING FROM 20 TO 5000 GeV. Cheng, H.; Walker, J. K.; Wu, T. T. (Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics; National Accelerator Lab., Batavia, Ill.; Harvard Univ., Cambridge, Mass. Gordon McKay Lab.). 1973. 17p. Dep. NTIS $3.00.

A simple model of hadron scattering from 20 to 5000 GeV is given which is based on the impact picture derived from quantum field theory. Numerical results, consistent with existing data are given and in addition the general behavior of high energy hadron-hadron elastic scattering. (auth)

9385 (JINR-D2-7110) AUTOMODELITY IN THE LARGE ANGLE ELASTIC SCATTERING AND HADRON STRUCTURE. Matveev, V. A.; Muradyan, R. M.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

From the principle of automodelity, advanced previously, the idea is developed that the particle interaction processes with large momentum transfers are determined by the local hadron structure. The connection of the asymptotic behavior of the cross sections of particle scattering at large angles with the number of composing subparticles (quarks) is found. (auth)

9386 (N-73-14735) INCLUSIVE VECTOR MESON PRODUCTION AT SMALL t IN THE DUAL RESONANCE MODEL. Randa, J. (Illinois Univ., Urbana. Dept. of Physics). 1972. 31p. (Ill-(th)-72-11). NTIS.

Starting from the B8 of Chan and Tsou and using the results of DeTar, Kang, Tan, and Weis, expressions were obtained for the cross section and density matrix elements of vector mesons produced in inclusive reactions. The behavior of these quantities as functions of energy, missing mass, and momentum transfer is explored. (auth)

9387 (RLO–2230-T-4-85) TRANSVERSE MOMENTUM DISTRIBUTION IN INCLUSIVE REACTIONS AND RELATIONSHIP BETWEEN THE DIFFRACTIVE EXCITATION MODEL AND THE THERMODYNAMIC MODEL. Gordon, E. M. (Oregon Univ., Eugene. Inst. of Theoretical Science). 1972. Contract AT(45-1)-2230. 10p. Dep. NTIS $3.00.

It is shown that the choice of a Planck distribution for the cluster decay function in the diffractive excitation model gives good agreement with the inclusive transverse momentum spectrum of pions in pp collisions. Since this kind of distribution is associated with the thermodynamic model, the relationship between the two models is examined. (auth)

9388 (RLO–2230-T-4-86) SLOPE OF THE FORWARD PEAK: AN S-CHANNEL ANALYSIS. Hwa, R. C. (Oregon Univ., Eugene). 9 Jan 1973. Contract AT(45-1)-2230. 28p. Dep. NTIS $3.50.

Starting from the exact multiparticle unitarity relation, the derivative extension of the optical theorem is derived. The slope of the forward peak is then related in a model-independent way to the rotational properties of production amplitudes. A sequential representation is developed for treating an n-particle state. The formalism is then applied to the multiperipheral and diffractive models. The analysis makes clear the mechanisms in which the forward slope is built up in those models. In the case of the multiperipheral model the slope is proportional to the number of links in the multiperipheral chain. Quantitatively, the slope of the Pomeranchuk trajectory at t = 0 is too large. In an oversimplified version of the diffractive model the predicted slope of the elastic forward peak is one-half the mean slope, the average being taken over all two-cluster production processes; consequently, it is too small. The realistic high-energy model is somewhere between the two extremes considered. (auth)

9389 (RLO-2230-T-4-88) RELATIONSHIP BETWEEN DIFFRACTIVE PEAKS OF ELASTIC AND EXCITATION PROCESSES. Gordon, E. M.; Hwa, R. C. (Oregon Univ., Eugene. Inst. of Theoretical Science). 16 Apr 1973. Contract AT(45-1)-2230. 15p. Dep. NTIS $3.00.

By considering the anisotropy of the decay distributions of excited clusters, or equivalently their spins, in the diffractive excitation model, it is shown how the forward peak of the differential cross section for excitation is broadened. Furthermore, it is shown through unitarity how the elastic peak is sharpened. An algebraic relation between the slopes is derived. In a self-consistent model, the excitation slope for large cluster masses is half the elastic slope in agreement with experiment. (auth)

9390 RANK STRUCTURE OF EXCLUSIVE REACTIONS AND CHARACTERISTIC FEATURES OF INCLUSIVE SPECTRA. Inclusive Reactions and Urbaryon Rearrangement Diagrams. IV. Noda, H.; Kinoshita, K. (Kyushu Univ., Fukuoka). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2329-2345(Dec 1972).

The magnitude of channel cross sections shows a rank structure which gives the degree of suppression of strangeness and baryon number creations. The effects of the structure to inclusive spectra are discussed. In particular the systematic understanding of experimental data on single-particle distribution is given on the bases of the reduction rule of urbaryon lines and the rank structure. (auth)

9391 DERIVATION OF THE VIRASORO CONDITIONS IN THE STRING MODEL. Konisi, G. (Kwansei Gakuin Univ., Nishinomiya, Japan). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2008-2023(Dec 1972).

It is shown that the Virasoro conditions and the trajectory equation in the dual resonance model can be derived from the Lagrange coordinate condition in the Nambu–Susskind string model. The proof is based on a causality requirement concerning the vibrational waves on the string and on a lagrangian theory of the free relativistic string with the ordinary time parameter. The case of interaction with an external scalar field is also discussed. (auth)

9392 GENERAL VERTEX WITH PHYSICAL EXCITED PARTICLES IN THE DUAL RESONANCE MODEL OF THE VIRASORO CASE. Sohkawa, T. (Osaka City Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2024-2043(Dec 1972).

The transformation properties of the asymmetrical general vertex of the dual resonance model under the projective group are investigated. It is shown that, in the Virasoro case, the vertex with the physical state is covariant under the group and is equivalent to the vertex introduced by Campagna et al. Using this equality, it can be directly shown that an amplitude for N external excited particles constructed by using the vertex is equal to the amplitude obtained from repeated factorization of tree dual graph. (auth)

9393 FEYNMAN-LIKE RULES FOR THE DUAL-RESONANCE MODEL ON THE BASIS OF THE NAKANISHI DECOMPOSITION. Yoneya, T. (Hokkaido Univ., Sappora). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2044-2065(Dec 1972).

Feynman-like rules are presented for the dual-resonance model, whose counting rule is the same as in the conventional field theory. Our approach is based on the Nakanishi decomposition of the n-point Veneziano formula. This decomposition is extended to general loop amplitudes. One advantage of this scheme is that the periodicity problem for the loop amplitudes is automatically removed, at least at the one-loop level. (auth)

9394 CONTINUING SEARCH FOR QUARKS. Jones, L. W. (Univ. of Michigan, Ann Arbor). Phys. Today; 26: No. 5, 30-33; 35: 37(May 1973).

A review is given of experimental searches for quarks with accelerators, in cosmic radiation and in stable matter. Various detection methods are discussed, and experiments with tentatively positive evidence for quarks are cited. It is concluded that at present no strong evidence exists for the physical existence of fractionally charged elementary particles. (LBS)

9395 WEINBERG'S GAUGE MODEL FOR WEAK AND ELECTROMAGNETIC INTERACTIONS WITH HAN–NAMBU QUARKS. Achiman, Y. (Univ., Heidelberg). Nucl. Phys.; B56: No. 2, 635-641(1973).

A version of the Weinberg model is constructed using Han–Nambu quarks, in order to obtain the conventional classification of hadrons. The use of Han–Nambu quarks leads to a suppression of neutrinos coupled to the $\Delta S = 0$ hadronic current, while the coupling to neutral leptonic currents remains as in Weinberg's theory. (auth)

9396 THERMAL CHAOS AND COHERENCE IN MULTIPLICITY DISTRIBUTIONS AT HIGH ENERGIES. Giovannini, A. (Univ., Turin). Nuovo Cim.; 15A: No. 3, 543-551(1 Jun 1973).

The dynamic assumptions of the statistical generalization of the one-dimensional multiperipheral bootstrap model proposed by the present author are discussed by means of an optical analogy. No dramatic contradictions are found between the experimental indications on scaling and correlation parameters and the predictions of the model. (auth)

9397 SPIN ZERO COUPLINGS IN THE VENEZIANO MODEL. Dobson Jr., Peter N. (University of Hawaii, Honolulu, Hawaii). J. Math. Phys. (N.Y.) 14: No. 4, 541-547 (Apr 1973).

The problem of the positivity of the residues in the simple Veneziano model is investigated. Previous studies of this problem have concentrated on the residues of poles lying along specific daughter trajectories, and hence needed to work only with polynomials of fixed low degree. A technique is developed here which is applied to all the spin zero daughters in the model, and which therefore deals with polynomials of arbitrarily high degree. It is found that the spin zero residues are all positive if $\alpha_0 \geq 1/2$, where α_0 is the intercept of the leading trajectory in the model. (auth)

Strong (Baryon No. = 0)

9398 (COO-3227-32) RATIO OF REAL TO IMAGINARY PARTS FOR pp, $\bar{p}p$, $\pi^{\pm}p$, AND $K^{\pm}p$ FORWARD ELASTIC SCATTERING AMPLITUDES FROM 50 TO 5000 GeV. Cheng, H.; Walker, J. K.; Wu, T. T. (Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics; National Accelerator Lab., Batavia, Ill.; Harvard Univ., Cambridge, Mass. Gordon McKay Lab.). 1973. 10p. Dep. NTIS $3.00.

Without introducing any additional parameter or assumption, a model for hadron scattering based on the impact picture is used to predict the ratio of the real to imaginary parts of various forward elastic scattering processes at high energies. (auth)

9399 (ITEF-950) DESCRIPTION OF INELASTIC PROCESSES IN A SINGLE-PION EXCHANGE MODEL. Boreskov, K. G.; Kaidalov, A. B.; Ponomarev, L. A. (Gosudarstvennyi Komitet Po Ispol'Zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1972. 70p. (In Russian). Dep. NTIS (U. S. Sales Only) $5.50.

General questions connected with the applicability of a multiperipheral model of single pion exchange to a description of the processes of the multiple production of high-energy π-mesons were considered. The model simulation "OPER" for single pion exchange was formulated. The model satisfactorily described the totality of experimental data relating to the reactions $pp \to pn\pi^+$ and $\pi^-p \to \pi^+\pi^-n$ in the energy range from 2 to 30 GeV. Regge parametrization of the amplitudes of $\pi\pi$-scattering was discussed in the region of mass of the 2-x system of π-mesons $M_{\pi\pi} > 2$ GeV/c^2 The problem of multiple production of π-mesons in $\pi\pi$-encounters was solved. The energy behavior of the cross sections of production 2-x, 4-x, ... 10 π-mesons was found. The total cross section of $\pi\pi$-scattering, ob tained by adding partials, appeared to be constant over the energy changes from $S \sim 100$ GeV^2 to $S \sim 1000$ GeV^2. The applicability of the model of single pion exchange to a description of inclusive spectra is discussed. (tr-auth)

9400 (JINR-E2-7050) RELATIVISTIC QUARK MODEL OF MESONS IN INFINITE MOMENTUM FRAME. Atanasov, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

A relativistic three-dimensional equation is proposed for describing the mesons as bound states of a quark and an antiquark in infinite momentum frame. Applying the modified perturbation procedure, Regge linear trajectories are obtained. (auth)

9401 (LBL-1777) ZEROS IN $\pi\pi$ SCATTERING. Pennington, M. R. (California Univ., Berkeley. Lawrence Berkeley

Lab.). 11 Apr 1973. Contract W-7405-eng-48. 28p. (CONF-730319-1). Dep. NTIS $3.50.

From international conference on $\pi-\pi$ scattering as associated topics; Tallahassee, Florida, USA (28 Mar 1973).

It is discussed how zeros in $\pi\pi$ scattering relate various dynamical aspects of the scattering amplitude. In particular, the way in which many differing roles, such as the Legendre zeros of resonances, double-pole-killing zeros, the high energy crossover zero and the Adler zero, can be played by the same zero contour is considered. It is emphasized that the study of the scattering amplitude is essentially one of looking at zeros travelling across the Mandelstam plane. (auth)

9402 MASSIVE μ-PAIR PRODUCTION IN THE DUAL-RESONANCE MODEL. Biyajima, M. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2323-2328(Dec 1972).

The dual-resonance model which satisfies the gauge-invariance condition is utilized to discuss the massive μ-pair production in the hadron-hadron interactions. Our result is consistent with the recent experiment: The evaluated cross section is proportional to $q^{-5}s^{-1}(q^2$ is the dimuon mass and s is the hadron energy squared). Here the $(q^{-2}s^{-1})$ factor is peculiar to the dual-resonance model. (auth)

9403 LOW ENERGY $\pi\pi$ SCATTERING IN A CROSSING-SYMMETRIC MODEL. Arneodo, A.; Donohue, J. T. (Univ., Nice). Nuovo Cim.; 15A: No. 1, 107-126(1 May 1973).

Several topics in low-energy $\pi-\pi$ scattering are investigated using a model which is crossing-symmetric, approximately unitary, and constrained to satisfy certain finite-energy sum rules. The sensitivity of some recently derived inequalities among S-, P- and D-wave amplitudes is studied, and it is found that although these inequalities are highly sensitive to small violations of crossing symmetry, they are satisfied by several different choices of parameters in our model. The properties of the ρ-meson and of the asymptotic cross section consistent with our low-energy behavior are discussed; the ρ width tends to be too small, but σ_∞ is quite consistent with factorization. A solution with a broad, low-mass ϵ_0-resonance is examined, but the model cannot cope with such a resonance, should it exist. Finally, the contours of zeros of the real and imaginary parts of the amplitude are traced in the (t,s,u)-plane. (auth)

9404 PHENOMENOLOGICAL FITS TO HIGH ENERGY DATA IN THE DOUBLE-REGGE-POLE MODEL. Bialkowski, G. (Univ., Warsaw); Krawczyk, M.; Krzyzanowski, W. Nuovo Cim; 15A: No. 1, 1-20(1 May 1973).

Phenomenological fits to high-energy data in the Regge-dipole model are presented. In our approach the pomeron is a simple Regge-pole. This model, which is simpler than, for example, the Regge-cut models, can well describe the experimental data. (auth)

9405 UNIFIED MODEL OF THE ONE-BOSON- AND REGGEON-EXCHANGE MECHANISM IN N-N AND N-$\bar{N}$ INTERACTION Ueda, T. (Osaka Univ., Toyonaka, Japan). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2276-2282(Dec 1972).

This is an application of our extended-boson exchange amplitude to p-p and p-$\bar{p}$ scattering at high energies (10 ~ 30 GeV) and at forward angles with $|t| \lesssim (\mathrm{GeV/c})^2$. The amplitude is constructed such that it is reducible to the one-boson exchange amplitude in the low energy region, while it tends to the Reggeon-exchange amplitude at small angles and to a modified one-boson-exchange amplitude at large angles in the high energy region. It is found that the amplitude is quantitatively adaptable to both data of the low and high energies with $|t| \lesssim 1\ (\mathrm{GeV/c})^2$. (auth)

9406 CROSSING SUM RULES APPLIED TO INEQUALITIES ON $\pi\pi$ S AND P WAVES. Grassberger, P. Nucl. Phys.; B56: No. 2, 536-560(1973).

The crossing conditions for the physical absorptive parts are used to improve rigorous constraints of the Martin type for $\pi\pi$ S and P waves in the unphysical region $0 \le s \le 4$. In particular, (i) inequalities for the scattering lengths in terms of the amplitudes at s = 0, (ii) inequalities relating only I = 0 and I = 2 S waves, (iii) the inequalities of Auberson, Brander, Mahoux and Martin are considered. Though some of these new inequalities seem to be very tight, they are satisfied in nearly all tested models. (auth)

9407 SMOOTHNESS OF PION AMPLITUDES AND PCAC. Pennington, M. R. (Univ. of California, Berkeley). Nucl. Phys.; B56: No. 2, 381-385(1973).

The essentially obvious result is pointed out that if the massless pion amplitude is the smooth finite limit of the massive pion world, the Adler self-consistency condition must be true. (auth)

9408 SLOW ONSET OF THE SCALING LIMIT AND RESONANCE DOMINANCE. Sasaki, T. (Tokyo Univ.); Mural, N. Lett. Nuovo Cim.; 7: No. 4, 129-132(26 May 1973).

An approach to the scaling limit of various pion inclusive spectra in the central region within the framework of resonance dominance is studied. The approach can explain with a highly unified picture final-particle spectra in the whole x region and above the incident laboratory momentum of 20 or 30 GeV/c. The parameters and total pion distributions at x = 0 are found for the reactions $\pi^+ + p$, $\pi^- + p$, $\gamma + p$, and $p + p$. (JFP)

Strong (Baryon No. = 1)

Refer also to abstract 9338.

9409 (JINR-P2-7037) MULTIPOLE ANALYSIS OF THE PROCESS $\pi^-p \to ne^+e^-$ IN THE BORN APPROXIMATION. Petrova, S. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The results of the general multipole decomposition of the $\pi^-p \to ne^+e^-$ process amplitude are presented. The expressions are obtained for multipoles in the Born approximation. The numerical calculations of multipoles are performed and their contribution to the cross section is determined. The dependence of these values on the form factors of a π-meson and a nucleon are studied. (auth)

9410 (RLO-2230-T-4-90) DISPERSION RELATIONS IN THE TRANSVERSE MOMENTUM. Yu, W. Y. (Oregon Univ., Eugene. Dept. of Physics). Mar 1973. 56p. Dep. NTIS $5.00.

Thesis.

Dispersion relations in the transverse momentum are written for pion-nucleon scattering. (JFP)

9411 DOES AN F-MESON BEHAVE LIKE A MASSIVE GRAVITON. Takeda, G.; Itabashi, K.; Akiba, T. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2077-2081(Dec 1972).

The reaction $\pi^-p \to f^0n$ is studied to see whether an f-meson couples to the conserved energy momentum tensor and thus behaves like a massive graviton. Detailed experiments on the differential cross sections for the reaction $\pi^-p \to f^0n$ at extremely small momentum transfers and large energies seem to be useful to answer the question. (auth)

9412 INTERACTIONS OF BARYONS IN A RELATIVISTIC COMPOSITE MODEL. Teshima, T. (Chuba Inst. of Tech., Aichi, Japan); Umemura, I. Progr. Theor. Phys. (Kyoto); 48: No. 6, 2358-2376(Dec 1972).

The interactions of baryons and their resonances are investigated on the basis of a relativistic composite model in terms of the B-S amplitudes. By imposing appropriate conditions, the B-S amplitudes are constructed, which are different from those obtained by a method of SU(6) or $\tilde{U}(12)$ symmetry. This difference may be attributed partially to the effects of interactions and relative motion of urbaryons. From the analysis of various interactions, it is shown that these effects are absorbed in a simplified form of B-S amplitudes as if they were small. The absolute values of magnetic moments, $NN\pi$ coupling constant and $N^*N\pi$ coupling constant are calculated in good agreement with experiment. The experimental branching ratios of β-decay are also reproduced by our approach. (auth)

9413 CLASSIFICATION OF BARYONS IN AN SU(3) REGGE SCHEME. Ida, M. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2346-2357(Dec 1972).

Evidence favoring the existence of non-degenerate parity partners and of baryonic daughter states is presented. Baryonic resonances in the mass region below ~1900 MeV are classified into four Regge families belonging to the SU(3) representations of 1, 8, 8 and 10. This leads to a new interpretation of parity doublets as approximate degeneracy between two octet parent trajectories. Exchange degeneracy patterns and baryon spectra in the scheme are discussed in comparison with those previously proposed. (auth)

9414 VENEZIANOIZED SHORT-RANGE POTENTIAL AND THE (3,3)πN RESONANCE. Imoto, M. (Nihon Univ., Chiba, Japan). Progr. Theor. Phys. (Kyoto); 48: No. 6, 1923-1933(Dec 1972).

By using the Venezianoized short range potential in addition to the long range potential, the position of the 33πN resonance is determined. It is shown that this Venezianoized short range potential is repulsive and is important to produce the 33πN resonance. The pole-cut duality is shown in the scheme of the Mandelstam representation with the strip approximation. (auth)

9415 EXACT UPPER BOUND FOR PION-NUCLEON COUPLING CONSTANT. Okubo, S. (Univ. of Rochester, NY). Progr. Theor. Phys. (Kyoto); 48: No. 6, 1986-2007(Dec 1972).

An exact upper bound for pion-nucleon coupling constant g which has been originally discovered by Geshkenbein and Ioffe is rede-

rived without assuming numbers of subtractions for spectral representation of $S_F'(p)$. Also, it is proved that their bound is violated if and only if the ghost-like pole discussed by Goebel and Sakita appears, when $S_F'(p)$ has one zero point. It is computed that the bound leads to $g^2 \leq 20$ in the exact SU(3) limit, which is very close to the experimental value $g^2 = 15$. The d and f coefficients of baryon-meson octet coupling constants are shown to be restricted to $0.30 \leq d \leq 0.94$. Also, the renormalization constant Z_2 of the nucleon must satisfy $0.85 \geq Z_2 \geq 0$, irrespective of any dynamical detail. (auth)

9416 FINITE-ENERGY SUM RULE IN THE INCLUSIVE REACTION AND ITS APPLICATION TO THE TRIPLE-REGGE AMPLITUDE. Ohba, I.; Tamama, T. (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 48: No. 6, 2301-2310(Dec 1972).

To investigate the six-point function, the finite-energy sum rule is derived and is applied to $\pi^- + p \to \pi^- +$ anything and $p + p \to p +$ anything processes. It is shown that the most dominant contributions come not from the triple-Pomeron coupling but from the meson-meson-Pomeron coupling for the "background" term and the Pomeron–Pomeron-meson coupling for the resonance term. The proposition is made that the Harari–Freund conjecture also holds for the off-mass-shell amplitude, such as Reggeon + p → Reggeon + p scattering amplitude. (auth)

9417 SOME APPLICATIONS OF DUALITY IN STRONG INTERACTIONS. Dixit, V. V. Lafayette, IN; Purdue Univ. (1972). 91p. University Microfilms Order No. 73-6011.

Thesis (Ph. D.).

The evolution of the concept of duality is discussed. Using a simple procedure for separating Pomeron and non-Pomeron Regge pole contributions to various pairs of meson-baryon and baryon-antibaryon total cross sections, F/D ratios for the helicity-nonflip couplings of vector and tensor meson octet trajectories to the baryons at t = 0 are determined from the experimental data. Local and semi-local duality conditions are applied to the resonance contributions to the backward $\bar{K}N$ scattering amplitude and predictions concerning the relative partial widths of different Σ^* and Λ^* resonances are made. In a somewhat different application of duality, the $\pi\pi$ Veneziano amplitude is normalized by using the ABFST multiperipheral model. In addition to the usual π exchange, ω and K exchanges are also considered and the $\pi\pi \to \pi\pi$ graphs are summed approximately by projecting out in to crossed channel partial waves (which are then continued to unphysical angular momenta) and constructing a diagonal [1,1] Padé approximant. The unitarity requirement is thus satisfied in the elastic region of that channel. Then, by requiring that there be an output pole at $t \simeq 0$ in the unphysical $I = 1$, $J = \frac{1}{2}$ $\pi\pi$ state and that its residue be consistent with the one predicted by the Veneziano model, the normalization constant of the Veneziano amplitude is determined. (Diss. Abstr. Int., B)

9418 TWO-COMPONENT DESCRIPTION OF INCLUSIVE CORRELATIONS FOR A FIXED PRONG NUMBER. Rama Rao, I.; Sarma, K. V. L. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; B56: No. 2, 597-604(1973).

It is pointed out that the two-component model of particle production can explain the observed structures in the correlation function of pairs of negative pions as a function of rapidity difference for a fixed prong number. It is argued that as the prong number increases this correlation function should become zero or negative at $\Delta y \simeq 0$. (auth)

9419 DIFFERENT SETS OF PHASE SHIFTS FOR THE SAME DIFFERENTIAL CROSS SECTION AND POLARIZATION IN SPIN-0–SPIN-$\frac{1}{2}$ ELASTIC SCATTERING. Berends, F. A.; Ruijsenaars, S. N. M. (Univ., Leiden). Nucl. Phys.; B56: No. 2, 525-535 (1973).

It is shown by construction that different sets of phase shifts exist, giving the same cross section and polarization for elastic spin-0–spin-$\frac{1}{2}$ scattering. All possible cases for S-P wave scattering are constructed. Measurement of the R- and A-parameters resolves the ambiguities. (auth)

9420 REGULARITIES IN THE MASS DEPENDENCE OF THE SLOPES IN HADRONIC PRODUCTION PROCESSES. Gula, A. (Inst. of Nuclear Tech., Krakow). Lett. Nuovo Cim., 7: No. 2, 63-68(12 May 1973).

Data on the mass dependence of the slope of the differential cross sections in hadron production interactions are parametrized, and it is shown that the slope parameter exhibits two regularities. It is noted that the appearance of these regularities would indicate a common mechanism responsible for the decrease of slope in all production processes. (LBS)

9421 REGGE AMPLITUDES FOR $\pi^- p \to \eta n$ and $K^- p \to \eta\Lambda(\Sigma)$ REACTIONS. Minami, S.; Terada, M. (Osaka City Univ.). Lett. Nuovo Cim.; 7: No. 3, 113-116(19 May 1973).

The properties of the amplitudes for the $\pi^- p \to \eta n$ and $K^- p \to \eta\Lambda(\Sigma)$ reactions in the forward and backward directions are studied. It is emphasized that 1) the nonperipheral structure of the A_2 exchange amplitude for the $\pi^- p \to \eta n$ reaction comes from the special properties of the direct-channel resonances and 2) the A_2 exchange amplitudes for other reactions, such as those for elastic $K^\pm p$ scattering, may be dominated by the peripheral partial waves. (LBS)

Strong (Baryon No. ≥ 2)

Refer also to abstract 9331.

9422 (JINR-E2-7041) STRAIGHT LINE PATH METHOD AND THE EIKONAL PROBLEM. Kuleshov, S. P.; Matveev, V. A.; Sisakyan, A. N.; Smodyrev, M. A.; Tavkhelidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

An investigation is made of a structure of "noneikonal" contributions to the two-nucleon scattering amplitude described by the sum of ladder type graphs in the scalar model. (auth)

9423 (JINR-E4-7069) SOME APPROACHES FOR SOLVING THE THREE-BODY PROBLEM AT POSITIVE ENERGY. Belyaev, V. B.; Efimov, V. N.; Tkachenko, E. G.; Schulz, H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The quartet neutron-deuteron scattering with zero-range interaction at total positive energies is considered. The corresponding integral equations with moving singularities are solved using two independent methods. In the first method one makes use of the smoothness of the iterated kernel, while in the second one the piecewise smoothness of the solution of the integral equation was supposed. (auth)

9424 (N-72-32679) COMPARISON OF EXACT AND APPROXIMATE EVALUATIONS OF THE SINGLE-SCATTERING INTEGRAL IN NUCLEON–DEUTERON ELASTIC SCATTERING. Wilson, J. W. (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Oct 1972. 20p. (NASA-TN-D-6884; L-8369). NTIS.

The exact nucleon–deuteron elastic single scattering integral was calculated numerically in order to evaluate errors in sticking factor approximations. A similar analysis made by using S wave separable potentials concluded that errors for these approximations were negligible except near backward angles where they were found to be about 10 percent. (auth) (STAR)

9425 MASSIVE μ-PAIR PRODUCTION IN HIGH ENERGY p–p SCATTERING. Kaufman, A. New York; New York Univ. (1972). 76p. University Microfilms Order No. 73-11,723.

Thesis (Ph. D.).

It is argued that operator product expansions near the light-cone and Regge theory can be used to analyze the massive μ-pair production process in high energy p–p scattering. The triple differential cross section for the process is then obtained from these basic assumptions and it is seen to be given in terms of integrals over four unknown functions $\Psi_1(\alpha\xi^2, \alpha'\xi^{1-2})$ that the theory requires to be symmetric functions of fast decrease in their variables. Without further assumptions it is shown, via the mean value theorem for monotonic functions, that the theory developed reproduces the main features of the experimental data quite well. Thus, the dimuon invariant mass differential cross section $d\sigma/d(q^2)^{1/2}$ displays the characteristic shoulder behavior of the data at $(q^2)^{1/2} \sim 3$ GeV/c^2. Such shoulder behavior is provided by the change of regime from the fragmentation region prevailing at small q^2 to the pionization region prevailing at large q^2. The fast decrease of the laboratory transversal momentum differential cross section $d\sigma/dq_1^2$ with q_1^2, observed experimentally, also results from the analysis. Finally, a model is devised on which the comparison with the data is carried out to the end with excellent results. Specifically, the Ψ_1's are chosen to be exponential functions and a SLAC like threshold behavior is implemented on the fragmentation contribution to the triple differential cross section. The set of unknown parameters characterizing the strength of the exponentials as well as the relative importance of the fragmentation versus pionization contributions is fixed by the requirement that the theory fit well the invariant mass differential cross section. All other cross sections are then seen to be reproduced quite satisfactorily within the model. (Diss. Abstr. Int., B)

9426 ENERGY DEPENDENCE OF THE SHADOW TERM IN PION–DEUTERON SCATTERING. Matthiae, G. (Istituto Superiore di Sanita, Rome). Nucl. Phys.; B56: No. 2, 613-616 (1973).

The energy dependence of the shadow term in pion–deuteron

scattering is discussed in connection with data in the energy range from 15 to 60 GeV. The contribution of regenerative effects, following diffractive production, is studied. (auth)

9427 TWO-PION EXCHANGE ΛN POTENTIAL. Riska, D. O. (State Univ. of New York, Stony Brook). AT(11-1)-3001. Nucl. Phys.; B56: No. 2, 445-476(1973).

The two-pion exchange contribution to the ΛN potential is constructed from the field-theoretical scattering amplitude. The potential is constructed both for a single-channel description of the ΛN interaction and for a coupled-channel treatment of the ΛN and ΣN interactions. The resulting TPE ΛN matrix element is real and weakly energy dependent up to threshold for π-production in the coupled-channel framework. The Adler consistency condition for the input $\pi\Lambda$ and πN amplitudes, as well as the s-wave $\pi\pi$ interaction are taken into account. The rescattering effects in the intermediate state are approximated by the low-mass πB resonances in the sharp resonance approximation. (auth)

9428 INCLUSIVE THERMODYNAMICAL SPECTRA OF NEUTRAL PARTICLES. Letessier, J.; Tounsi, A. (Institut de Physique Nucleaire, Paris). Nuovo Cim.; 15A: No. 3, 358-370 (1 Jun 1973).

The study of one-particle inclusive spectra is extended within the framework of the thermodynamical model, with particular assumptions, to neutral particles (n, Λ, K^0_l, π^0, γ). With at most one free parameter for each spectrum good agreement with the data is obtained except for the γ-spectra. Gamma production is described as proceeding via π^0 decay, without a free parameter, and the good agreement observed at 24 GeV/c is surprisingly lost at ISR energies. If the present γ data at ISR energies were confirmed, it would be difficult to explain this single disagreement within the assumptions. (auth)

9429 CALCULATING NEUTRON–DEUTERON SCATTERING USING THE SU_3 BASIS OF THREE-PARTICLE STATES. Beard, A. N.; Fong, R. (Univ. of Durham, Eng.). Nuovo Cim.; 15A: No. 3, 337-357(1 Jun 1973).

Three-particle states have been classified by Dragt according to the group SU_3. The usefulness of this basis in practical calculations is investigated by a consideration of the quartet contribution to neutron–deuteron scattering. (auth)

Particle Invariance Principles and Symmetries

General

9430 (JINR-P2-7091) TRANSFORMATION OF THE COORDINATE INVERSION IN THE CONFORMAL INVARIANCE THEORY. Dao Vong Dyk (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The coordinate inversion transformation in the conformal invariance theory is considered. A simple method is presented for finding the corresponding law of the field operator transformation. This method is then applied to studying the nonlinear realization of the conformal group. (auth)

9431 (ORO-3992-125) MASS ZERO INDECOMPOSABLE REPRESENTATIONS OF THE POINCARE GROUP. Mathews, P. M.; Seetharaman, M.; Simon, M. T. (Texas Univ., Austin. Center for Particle Theory). 1973. 16p. (CPT-86). Dep. NTIS $3.00.

Considering the space of massless-particle wave functions transforming locally according to the irreducible representation $D^{(m,n)}$ of the homogeneous Lorentz group, the matrices constituting the (reducible but indecomposable) representation of Lorentz transformations with respect to a helicity basis are determined explicitly by a direct and elementary method. (auth)

9432 A NOTE ON VECTOR-MESON DOMINANCE AND THE COMPACTNESS OF CURRENT ALGEBRA. de Azcárraga, J. A. (Department of Applied Mathematics and Theoretical Physics, University of Cambridge, England). J. Math. Phys. (N.Y.) 14: No. 2, 173-175 (Feb 1973).

It is shown that for any semisimple inner symmetry group (compact or not) the Lee-Weinberg-Zumino procedure applied to a Yang-Mills type Lagrangian leads to field algebra. The exclusion of the noncompact case is analyzed. (auth)

9433 SEMIGROUP CONTAINED IN SL_{2R} AND COMPLEX ANGULAR MOMENTUM. Soliani, G.; Toller, M. (CERN, Geneva). Nuovo Cim.; 15A: No. 3, 430-448(1 Jun 1973).

The relevant geometrical properties and a class of linear representations of a semigroup $\hat{S}$ contained in SL_{2R} are studied. These representations can be used in order to partially diagonalize the multiperipheral integral equation for spacelike four-momentum transfer. Moreover, they can be used for the harmonic analysis of some absorptive multiparticle amplitudes, which can be considered as functions on $\hat{S}$. A new approach to complex angular momentum is obtained, which has many advantages and in particular permits some peculiar phenomena as the Gell-Mann compensating mechanism and the Mandelstam twin symmetry to be interpreted. A class of norms, useful for the discussion of the convergence of the projection integrals on the representations of $\hat{S}$ is introduced, which define a generalized Laplace transform. The problem of the inversion of this transform is partially solved. (auth)

9434 ON THE WIGNER COEFFICIENTS OF SP(4) AND SO(5). Holman III, Wayne J. (Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado, 80302). J. Math. Phys. (N.Y.) 14: No. 4, 440-447 (Apr 1973).

The matrix elements of totally symmetric tensor operators in Sp(4), the spinor covering group of SO(5), are obtained by direct factorization of the corresponding Sp(4) *Sp(4) matrix element. The general Sp(4) *Sp(4) matrix element is factorized, and coefficients are obtained which possess a degree of symmetry higher than that of the canonical Wigner coefficients of Sp(4), but which do not form an orthonormal set in the multiplicity space. The canonical Wigner coefficients can, in principle, be derived from those obtained in different ways by a Schmidt orthogonalization process. (auth)

9435 THE REPRESENTATION THEORY OF SU(4) IN THE SP(4) BASIS. Holman III, Wayne J. (Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302). J. Math. Phys. (N.Y.) 14: No. 4, 448-455 (Apr 1973).

Basis states of irreducible representations of SU(4) in its Sp(4) basis are explicitly constructed in the boson calculus by the method of lowering operators. Expressions are derived for the Wigner coefficients of internal coupling and for the most general matrix which transforms an irreducible representation of SU(4) form its Sp(4) basis to a U(3) basis. (auth)

Applications (Electromagnetic and Weak)

9436 LORENTZ GROUP ANALYSIS OF HIGH ENERGY SCATTERING. Weissman, G. H. New York; New York Univ. (1972). 60p. University Microfilms Order No. 73-11,787. Thesis (Ph. D.).

The general theory of group representations is studied as applied to the Lorentz group. This leads immediately to a geometric interpretation of the behavior of functions defined over a space-time manifold. An integral transform is developed to accomplish the harmonic analysis of a configuration space function into representation functions of the Lorentz and dilatation groups. The recent SLAC electro-production experiment is discussed, with emphasis on interpretation of the scaling behavior. The relations between operator product expansions on the light-cone and the irreducible representations of the Lorentz and dilatation groups are examined. In particular it is found that the light-cone expansion provides a sufficient source for the essential observations made in the SLAC experiment. The origin of Regge poles and fixed poles is examined in detail, with the equivalence of scaling poles and Regge poles clearly demonstrated. The light-cone expansion is extended to other areas of configuration space to account for mass-shell poles and other singularities. The geometric interpretation of Lorentz group analysis leads to a uniquely simple explanation of scaling behavior in momentum space. This suggests future kinematical limits to be explored in high energy experiments. (Diss. Abstr. Int., B)

9437 HARD-MESON (3,3*) + (3*,3) MODEL FOR K_{l3} DECAY: POTENTIALITIES AND CONDITIONS FOR APPLICABILITY. Bessler, L. (Queen Mary Coll., London). Lett. Nuovo Cim.; 7: No. 4, 121-124(26 May 1973).

The hard-meson (3,3*) + (3*,3) model for broken chiral (SU(3) × SU(3)) symmetry for kaon three-body leptonic decay is examined and utilized more fully. (JFP)

Scattering Theory

Refer also to abstracts 9392, 9393, 9419, and 9422.

9438 (UCR-34-P-107-AX-1) ANNUAL REPORT FOR THE PERIOD SEPTEMBER 1, 1970–FEBRUARY 1, 1972. Kaus, P. E.; Desai, B. R. (California Univ., Riverside). [nd]. Contract AT(04-3)-34. 6p. Dep. NTIS $3.00.

Research on complex Regge poles and the Veneziano representation for high energy scattering is summarized. (JFP)

9439 NONLINEAR PADÉ APPROXIMANTS FOR LEGENDRE SERIES. Fleischer, J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544). J. Math. Phys. (N.Y.) 14: No. 2, 246-248 (Feb 1973).

We introduce a new kind of Padé approximant for Legendre series based on the solution of a nonlinear system of equations. These Padé approximants have many properties in common with the well-known Padé approximants for Taylor series. In the examples studied here, the poles and zeroes of the Padé approximants lie on the cut and separate each other—a property which one expects to hold in general for Padé approximants. A proof of convergence follows the same lines as for Taylor series. Moreover, it turned out that these nonlinear approximants converge more rapidly than the linear approximants introduced in an earlier work. They may become a powerful tool in the summation of Legendre series. (auth)

9440 GENERALIZED EIKONAL APPROXIMATION AND MULTIPLE-SCATTERING FORMALISM AT HIGH ENERGIES. Obu, M. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 48: No. 6, 1934-1959(Dec 1972).

A formalism for high-energy multiple-scattering is developed, which is similar to the Glauber formalism but does not assume the eikonal approximation. The time-dependent scattering theory is adopted to generalize this approximation. In the eikonal approximation together with the adiabatic one, the time-dependent interaction Hamiltonian in the interaction representation turns out to be commutative. Based on this commutative nature of the eikonal approximation a generalized approximation is proposed which assumes the commutativity itself. The extended approximation is called the generalized eikonal approximation (GEA) and is used to develop the extended multiple-scattering formalism. In the GEA the trajectory of the incident particle may deviate from the straight line, the trajectory adopted in the Glauber theory. Therefore, the extended formalism can be considered to be more reliable at large angles than the Glauber formalism. (auth)

9441 ASYMPTOTICALLY EXACT SOLUTIONS FOR SYSTEMS WITH SINGULAR POTENTIALS. Simenog, I. V. (Inst. of Theoretical Physics, Moscow). Teor. Mat. Fiz.; 15: No. 2, 266-279(May 1973). (In Russian).

It is shown that the Hartree approximation is exactly satisfied for the quantum mechanical systems with singular attractive potentials in the limit of the large particle number N. The one-particle Hartree solutions are asymptotically exact also for systems with bounded monotone interaction potential. (auth)

9442 IMPROVED DISTORTED-WAVE BORN APPROXIMATION FOR VIBRATIONALLY INELASTIC COLLISIONS: AVERAGING PROCEDURES. Chang, D. T. (National Tsing Hua Univ., Hsinchu, Taiwan). Chem. Phys. Lett.; 19: No. 1, 86-89(1 Mar 1973).

The classical averaging procedure of Roberts for the determination of the parameter C_n in the simple distortion potential, $V_n^0(x) = C_n \exp(-\alpha x)$, is examined further. An analogous quantum averaging procedure is also investigated. (auth)

9443 INVERSE SCATTERING PROBLEM WITH AN ENERGY DEPENDENT POTENTIAL. Jaulent, M. (Univ., Montpellier, France). Ann. Inst. Henri Poincare, Sect. A; 17: No. 4, 363-378 (1972).

The inverse scattering problem is considered for the radial s-wave Schroedinger equation with an energy-dependent potential, when there is no bound state. (France)

9444 REGGE-CUT DISCONTINUITIES AND ELASTIC UNITARITY. Creutz, Michael; Paige, Frank E.; Wang, Ling-Lie (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 30: No. 8, 343-345 (19 Feb 1973).

We show that elastic unitarity does not require the discontinuities of Regge cuts to vanish at the branch point when the momentum transfer is below the crossed-channel elastic threshold. This is in contrast to the conclusions of Bronzan and Jones. (auth)

9445 VARIATIONAL APPROACH TO THE QUANTUM THEORY OF SCATTERING. II. THE KOHN METHOD AND KATO EIGENVALUE PROBLEM. Kolker, H. J. (United Aircraft Research Laboratories, East Hartford, Connecticut 06108). J. Chem. Phys. 58: No. 6, 2288-2297 (15 Mar 1973).

Certain similarities between the equations arising in scattering theory and the variational approach to time dependent perturbation theory are used to show that the Kohn variational technique for solving scattering problems is equivalent to a variational method for calculating a special set of eigenfunctions, in terms of which the solution to the scattering problem is expanded. Contrary to the results of previous studies, the error term in the scattering problem is bound from below, and the Kohn method is equivalent to a minimum principle. Levinson's theorem is rederived, and extended to higher energies. On the basis of the theory presented in this study, a new method for calculating upper and lower bounds on the energies of resonance and Ramsauer-Townsend states is suggested. (auth)

9446 ON STOCHASTIC SCATTERING. Bassanini, Piero (Istituto Matematico, Università di Perugia, Italy). J. Math. Phys. (N.Y.) 14: No. 3, 402-405 (Mar 1973).

The Schrödinger equation for two-particle scattering with random potential is considered, including both the cases of a local and a nonlocal potential with convolution kernel. It is shown that the statistical fluctuations of the potential give rise to additional terms which increase the scattering cross section, and an evaluation of the additional terms in the Born approximation is given. A brief discussion about analyticity properties of the scattering amplitude under suitable assumptions is included. (auth)

9447 ON THE INVERSE PROBLEM FOR A HYPERBOLIC DISPERSIVE PARTIAL DIFFERENTIAL EQUATION. II. Weston, V. H.; Krueger, R. J. (Division of Mathematical Sciences, Purdue University, Indiana 47907). J. Math. Phys. (N.Y.) 14: No. 3, 406-408 (Mar 1973).

In a previous paper the inverse problem for a dispersive hyperbolic partial differential equation was shown to be reducible to a system of two coupled integral equations involving the kernels of the scattering operators. Here the uniqueness question is considered. The conditions on the scattering kernel to insure uniqueness of the solution of the system of integral equations are developed. (auth)

9448 ON THE CONVERGENCE OF SEPARABLE EXPANSIONS FOR THE T MATRIX. Osborn, T. A. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). J. Math. Phys. (N.Y.) 14: No. 3, 373-375 (Mar 1973).

We obtain theorems on the convergence of separable approximations for t matrices which derive from local potentials. We prove that convergence is impossible in the operator norm and the Hilbert-Schmidt norm. This result is universal and independent of the particular method used to construct the separable approximation. (auth)

9449 ASYMPTOTIC PROPERTIES OF SCATTERING AMPLITUDES THAT ARE BOUNDED BY THE MARTIN–FROISSART BOUND. Mickens, R. E. (Fisk Univ., Nashville). Lett. Nuovo Cim.; 7: No. 4, 147-149(26 May 1973).

Previous techniques are used to investigate the forward amplitude, bounds on the elastic cross sections and the normalized modulus, and the width of the forward peak for scattering amplitudes that are bounded by the Martin–Froissart bound. (JFP)

9450 BOUNDS, RESULTING FROM UNITARITY AND ANALYTICITY ON FORWARD SLOPES OF OVERLAP FUNCTIONS. Ajduk, Z. (CERN, Geneva). Nuovo Cim.; 15A: No. 3, 390-400 (1 Jun 1973).

Lower and upper bounds on forward slopes of overlap functions are obtained with the help of unitarity conditions, the polynomial boundedness and analyticity of elastic amplitudes. The results are compared with values of slopes obtained in Regge-pole models. (auth)

9451 NEW DERIVATION OF LOOP AMPLITUDES BY DIRECT INTEGRATION. Karpf, A. D.; Liehl, H. J.; Schuhmacher, H. F. (Univ., Freiburg i. B.). Nucl. Phys.; B56: No. 2, 565-588(1973).

The multi-loop amplitude of the general dual-resonant model is derived rigorously from the N-reggeon vertex of Lovelace by direct integration. Methods for the direct integral, the inversion of a complicated matrix and the evaluation of its determinant are developed. The identification with Abelian integrals is straightforward and instructive. These methods will also be very helpful for more general dual-resonant models. (auth)

9452 EXAMPLES OF PHASE-SHIFT AMBIGUITIES FOR SPINLESS ELASTIC SCATTERING. Berends, F. A.; Ruijsenaars, S. N. M. (Univ., Leiden). Nucl. Phys.; B56: No. 2, 507-524 (1973).

Pairs of different phase-shift sets are constructed, which give the same differential cross section for spinless elastic scattering. For SPD-wave scattering the construction leads to the Crichton ambiguity. When the method of construction is applied to SPDF-wave scattering four different types of ambiguities are found. The examples make it plausible that for higher L-values the number of ambiguities will increase. (auth)

9453 SYMMETRICAL BASIS FOR FADDEEV EQUATIONS. Alessandrini, J. L.; Vucetich, H. (Nacional Univ., La Plata). Nuovo Cim.; 15A: No. 3, 494-500(1 Jun 1973).

It is shown that the Faddeev equations can be treated in the frame of a three-body basis that takes into account the proper symmetries of the three-nucleon states. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

Refer also to abstract 9518.

9454 (JINR-P8-7008) MEASUREMENT OF HEAT CONDUCTIVITY OF SOLUTION OF ^{3}He–^{4}He AT SUPERFLOW TEMPERATURE. Borisov, N. S.; Neganov, B. S.; Feller, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 10p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Heat conductivity κ was measured for 6.4% solution of ^{3}He-^{4}He in the temperature range from 0.008°K to 0.1°K. For the region lower than 0.01°K the dependence is obtained $\kappa T = 30.5$ erg/s.cm. Measurement capillary diameter is 3.5 mm. (auth)

9455 (JINR-P8-7009) MEASUREMENT OF VISCOSITY OF SOLUTION OF ^{3}He IN ^{4}He AT SUPERLOW TEMPERATURES. Borisov, N. S.; Neganov, B. S.; Feller, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Viscosity of 6.4% solution of ^{3}He in ^{4}He was measured for the temperature range 8 to 10 mK. The temperature drop (which is due to viscose heating in the process) at the capillary ends was measured by two thermometers. It was found that if viscosity conforms to the law $\eta = \alpha T^{-2}$, then $\alpha = 5.3 \cdot 10^{-7}$ P grad^2. (auth)

9456 (KFK-1786) COOLING OF LONG TUBES WITH SUPERFLUID HELIUM. Krafft, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut,Fuer Experimentelle Kernphysik). Apr 1973. 86p. (In German). Dep. NTIS (U. S. Sales Only) $6.50.

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

Heat transport experiments with superfluid helium in pipes of 60 to 400 cm length and diameters between 0.3 to 1.0 cm show the existence of a critical heat flow density, when superfluidity breaks down and vaporization onset starts. The critical heat flux is mainly determined by the amount of superheating required for bubble formation. Assuming that nucleation occurs on the superfluid vortex lines or vortex rings the measured values of superheat can be explained. (auth)

9457 SYSTEM OF VORTICES IN ROTATING LIQUID HELIUM. Su, C. H. (Division of Applied Mathematics, Brown University, Providence, Rhode Island 02912). Phys. Fluids 16: No. 2, 182-187 (Feb 1973).

The Hamiltonian of a system of N vortex lines moving in an incompressible fluid contained in a circular cylinder is given. The equilibrium state of vortices is constructed through minimization of the energy of the system with the constraints of constancy of number of vortices and their total angular momentum. One and only one assumption is used throughout this work, that pair correlation between vortices is neglected. In equilibrium, the system of vortices rotates uniformly with respect to the central axis of the cylinder. The fluid does not rotate as a solid body, only approaches solid rotation as $N \to \infty$. Continuous distribution functions of vortices are found for all $N > 1$. For $N = 1$, the distribution is a delta function at the central axis of the cylinder. As N increases the distribution spreads out; in the limit $N \to \infty$, it becomes uniform throughout except for a thin layer of order $N^{-1/2}$ approaching the wall where the density goes to zero rapidly but continuously and remains zero up to the wall. The vortex-free region next to the wall has a thickness varying from $1-1/\sqrt{2}$ for $N=2$ to $1/\sqrt{N}$ for large N. (auth)

9458 VAPOR PRESSURE OF ^{3}He–^{4}He MIXTURES NEAR THE TRICRITICAL POINT. Goellner, G. J. Durham, NC; Duke Univ. (1973). 184p. University Microfilms Order No. 73-11,623.

Thesis (Ph. D.).

A high resolution study of the saturated vapor pressure of ^{3}He–^{4}He mixtures as a function of temperature and liquid concentration was made. The measurements extend over the temperature range from 0.5 to 1.20°K and the concentration range from 0.25 to 0.886 mole fraction of ^{3}He. The principal purpose of the experiment was to determine the asymptotic behavior of certain thermodynamic quantities in the region about the tricritical point which is located at T = 0.87°K and $x_3 = 0.67$. The use of an in situ pressure sensitive strain gauge with a resolution of 5×10^{-8} atmospheres helped to minimize thermal equilibrium times and obviated corrections due to thermomolecular pressure differences. The measurements have enabled one to determine the phase separation diagram and the lambda line in the T – x plane and good agreement is found with other groups. The concentration susceptibility $(\partial x/\partial \Delta)_T$ in the neighborhood of the tricritical point in which Δ is the difference in chemical potential between the two isotopes was determined. From these measurements several tricritical exponents related to the nonordering density x were evaluated. They are in good agreement with the theoretical predictions of Riedel and Wegner (1972). Although unable to resolve a predicted weak divergence in the concentration susceptibility at the lambda line, an anomalous behavior which may be related to this divergence was observed. Also a determination of the shape of the lambda line in $\Delta - T$ space from which the crossover exponent can be evaluated was made. This involved a calculation, based primarily on vapor pressure measurements, of the excess chemical potentials of ^{3}He and of ^{4}He over the temperature range from 0.8 to 1.20°K and over the entire concentration range. The concentration susceptibility data are found to be in good agreement with the scaled equation of state predicted by the theory of Riedel (1972) over a temperature range of approximately ±100 mK about the tricritical temperature and over a concentration range from approximately 0.60 to 0.80 mole fraction of ^{3}He. (Diss. Abstr. Int., B)

9459 THEORY OF THE MOBILITY OF IONS IN SUPERFLUID HELIUM. Perez, R. G. B. Urbana, IL; Univ. of Illinois (1972). 174p. University Microfilms Order No. 73-9875.

Thesis (Ph. D.).

A microscopic formulation of the mobility of ions in superfluid helium is derived. The mobility is given in terms of the cross section for the scattering of the ions with the elementary excitations of the liquid. The phonon-limited mobility of negative ions is calculated as a function of temperature using a semiclassical model for the ion–phonon scattering. The mobility of positive and negative ions in the roton limited regime is calculated as a function of temperature. A constant scattering transition matrix element is assumed and the ion recoil is taken into account. The mobility of positive ions in dilute solutions of ^{3}He in ^{4}He is calculated as a function of temperature and ^{3}He concentration. The interaction between the positive ion and the ^{3}He quasiparticles is found to be repulsive and long range. (Diss. Abstr. Int., B)

9460 SUPERFLUID TRANSPORT OVER A PERSPEX SURFACE. Esel'son, B. N.; Ivantsov, V. G.; Scherbachenko, R. I. (Physical and Technical Inst. of Low Temperatures, Kharkov). J. Low Temp. Phys.; 11: No. 1-2, 1-9(Apr 1973).

Transport phenomenon was investigated over the He(II) film on a perspex surface. Some peculiarities were established that were not observed before with other substrate materials. Emptying a perspex container takes place not only with positive but with negative level differences as well. In filling the container the transport starts only when the outer liquid surface is near the ampoule rim and ceases long before the levels become equal. A qualitative explanation of the observed phenomena was suggested, namely, as a result of electrification of the substrate. (auth)

9461 CONSERVING APPROXIMATION EVALUATION OF SUPERFLUID DENSITY WITHIN THE PAIR THEORY OF SUPERFLUIDS. Evans, W. A. B.; Rashid, R. I. M. A. (Univ. of Kent, Canterbury, Eng.). J. Low Temp. Phys.; 11: No. 1-2, 93-115 (Apr 1973).

The evaluation of the superfluid density, defined by the weak field response of the system, within the pairing theory of "pure" superfluids of Fermi or Bose statistics is considered. The need for evaluating this within what Baym and Kadanoff term a conserving approximation is emphasized. A formalism for generating manifestly conserving response kernels by analytic continuation at finite temperatures is developed and applied to the problem in question. At zero temperatures this is equivalent to the work of Nambu and others. The superfluid density is obtained in terms of the solution of a linear integral equation, the kernel and inhomogeneous term of which depends on the self-consistent equilibrium solution to the pair model. It is shown in general that this superfluid density tends to the full density at the absolute zero and vanishes above the critical temperature. Finally, some numerical work on the Bose superfluid is presented which is an extension of the calculations of Evans and Imry in the sense that a pseudopotential that more closely parameterizes the dispersion spectrum in He(II) is employed and that the superfluid density is evaluated as a function of temperature. (auth)

9462 TEMPERATURE DEPENDENCE OF THE FIELD EMISSION CURRENT IN He II. McClintock, P. V. E. (Univ. of Lancaster, Eng.). J. Phys., C (London); 6: No. 9, L186-L190(10 May 1973).

A simple model is proposed to account for the temperature dependence of the current from a field emitter at constant potential

in He II. The experimental data suggest that a new conduction mechanism, for which an effective mobility $\mu_v = (8.0 \pm 0.4) \times 10^{-3}$ cm^2 V^{-1} s^{-2} can be defined, is being observed below 0.5 K. (auth)

9463 ENERGY TRANSFER FROM A PULSED THERMAL SOURCE TO He II BELOW 0.3K. Pfeifer, C. D.; Luszczynski, K. (Univ. of Wisconsin, Madison). Phys. Rev. A; 7: No. 3, 1055-1061 (Mar 1973).

Measurements are presented on the angular distribution of energy flux radiated from a pulsed heater immersed in He II at low temperatures. Two small carbon heaters with different surface structures are located in a relatively large volume of He II maintained at temperatures in the range of 230 mK. Heater pulse widths are varied from 50 to 1000 μsec and heater power densities W_h extend from 0.1 to 20 W/cm^2. The radiated energy flux is monitored by a number of small carbon detectors which are located at distances of 1 and 2 cm from the heaters and at angles varying from 7° to 89° with respect to the heater normals. In the arrangement used, signals free of wall reflections can be observed. For values of W_h below 0.5 W/cm^2 the energy flux is found to travel at 235 ± 10 m/sec without any appreciable dispersion; the angular dependence of the flux is characteristic of the diffuse radiation of noninteracting flux of phonons emanating from the heater surface. When W_h exceeds 0.5 W/cm^2, the angular distribution is changed. Also, at higher heater power densities a second slower component appears in the radiated flux. This component travels at 130 ± 30 m/sec and is most likely associated with the helium excitations near the roton minimum. The results are discussed briefly in terms of model calculations for the effective source of excitations. It is shown that the experimental data are consistent with formation of a layer of relatively hot helium adjacent to the heater; this layer, whose shape and extent depends on the total energy flux produced by the heater, acts as the effective source of excitations radiated into the ambient low-temperature liquid helium. (auth)

9464 SOUND-MODULATED FLOW OF SUPERFLUID HELIUM THROUGH A SMALL ORIFICE: AN ATTEMPT TO OBSERVE THE AC JOSEPHSON EFFECT. Leiderer, P.; Pobell, F. (Physik-Department, Technische Universität, München, Germany). Phys. Rev. A 7: No. 3, 1130-1134 (Mar 1973).

Two chambers filled with superfluid helium to different levels were connected by a small orifice (10-15 μm). The flow of the liquid through the orifice was modulated by a sound field. With one experimental apparatus only a continuous flow was observed. With a modified apparatus it was possible to obtain stable states with no net flow at finite level differences between the baths. The spacing between these states is inversely proportional to the sound frequency. It depends on the total height of the liquid in one of the baths and not on the level difference between them. We conclude that the stable states of zero flow result from ultrasonic standing waves of the superfluid in one of the chambers. A phase coupling or Josephson effect can be excluded as an explanation for these states. (auth)

9465 SUPERFLUID ONSET, FREQUENCY RESPONSE, AND CONNECTIVITY. Dash, J. G.; Herb, J. A. (Physics Department, University of Washington, Seattle, Washington 98195). Phys. Rev. A 7: No. 4, 1427-1429 (Apr 1973).

A recent study of thin He^4 films by Chester, Yang, and Stephens using a quartz-microbalance technique has shown frequency anomalies ascribed to the onset of superfluidity. The data imply that superfluid is present at thicknesses less than those at the anomalies. We propose a model involving surface heterogeneities to explain the results. Using the same model, it is possible to resolve several puzzles associated with other studies of onset, including the anomalous attenuation of third sound. (auth)

Superconductivity

Refer also to abstracts 8686, 8733, 8738, and 10477.

9466 (AD-753847) HIGH AND LOW BIAS EFFECTS IN TUNNEL JUNCTIONS: IN PARTICULAR THE SYSTEM DYSPROSIUM-DYSPROSIUM OXIDE-LEAD. Robinson, J. E. (Illinois Univ., Urbana. Coordinated Science Lab.). May 1972. Contract DAAB07-67-C-0199, 144p. (UILU-ENG-72-2222). NTIS.

Observations of the superconducting energy gap structure in dI/dV-V plots have verified the successful fabrication of Dy-Dy oxide-Pb tunnel junctions. These junctions are characterized using tunneling spectroscopy and calculations based on various models of the junction potential. (auth)

9467 (IPP-4/104) INFLUENCE OF RADIATION DAMAGE ON THE PROPERTIES OF A SUPERCONDUCTOR. Soell, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Oct 1972. 65p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

After discussing problems of irradiation effects in solids, a review is given of the influence of radiation damage to the properties of type II superconductors. The damages in the critical temperature T_c, in the critical magnetic fields and in the critical current I_c are treated. The critical temperature T_c was reduced in all superconductors by particle irradiation. Clean type II superconductors such as Nb show an increase of the H_{c2} and the critical current, whereas by cold-worked NbZr and NbTi a decrease of I_c was measured. This decrease is explained by the reduction of the pinning strength of the dislocation wall. The behavior of the critical current of Nb_3Sn by irradiation depends on the value before the irradiation. For samples with initial low J_c-values, the critical current was increased by particle irradiation, whereas for samples with high J_c the opposite was measured. (auth)

9468 (NP-19771) MULTIFILAMENTARY COMPOSITES. Pouillange, J. P.; Prost, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 18 Mar 1971. 52p. (In French). Dep. NTIS (U.S. Sales Only) $4.75.

The circulating currents between superconducting filaments are reduced by twisting the composite. However in pulsed magnetic field, induced current loops still exist through the filaments and the matrix inside half a twist pitch. These induced currents increase the losses in the superconductor, but these supplementary losses are negligible if the twist pitch is much smaller than the critical pitch (practical case). They produce also losses in the matrix which are more important. Formulas for these losses are given. By twisting the filaments one obtains a perfect transposition in the external field but the filament layers remain coupled by the composite self field. The current distribution between the filaments is studied. The supplementary losses due to this inhomogeneous distribution do not seem to be very important. The self field instabilities are investigated. Due to the twist, the field does not remain normal to the filaments. This can also increase the losses. This effect will be experimentally and theoretically estimated. Measurements on small coils made from twisted composites and supplied by a pulsed current are reported. (auth)

9469 INFLUENCE OF THE SUPERCONDUCTING ENERGY GAP ON PHONON LINEWIDTHS IN NB_3SN. Axe, J. D.; Shirane, G. (Brookhaven National Laboratory, Upton, New York 11973). Phys. Rev. Lett. 30: No. 6, 214-216 (5 Feb 1973).

Inelastic neutron scattering, used to study acoustic phonon linewidths in Nb_3Sn, has revealed abrupt changes in certain phonon lifetimes in the vicinity of the superconducting transformation temperature, $T_c = 18.3$°K. This behavior arises because phonons with energy less than that of the temperature-dependent superconducting gap energy, 2Δ (T), are energetically incapable of decaying by excitation of electron-hole quasiparticle pairs. These measurements give $2\Delta(0) = 4.4k_BT_c$ and reveal a strong anisotropy in the electron-transverse phonon interaction. (auth)

9470 KINETIC INDUCTANCE IN THIN SUPERCONDUCTING AMORPHOUS BISMUTH FILMS. Baker, J. W. College Station, TX; Texas A and M Univ. (1972). 59p. University Microfilms Order No. 73-12,238.

Thesis (Ph. D.).

The kinetic inductance of thin superconducting amorphous bismuth films was measured. In the technique used the film is part of the inductance in the tank-circuit of a 13 MHz tunnel diode oscillator. The measured frequency changes are proportional to the square of the BCS temperature dependent superconducting penetration depth. From the temperature dependence of the oscillator frequency a value of the zero degree penetration depth λ(o) is determined. Also a value of the density of states at the Fermi surface N(o) from λ(o) based on the BCS expression for the penetration depth in a "dirty superconductor" is calculated. These experiments represent the first determination of λ(o) and N(o) for an amorphous superconductor. (Diss. Abstr. Int., B)

9471 CRITICAL TEMPERATURE OF THIN ALUMINUM SUPERCONDUCTING FILMS. Russell, T. J. IV. New Orleans; Tulane Univ. (1972). 93p. University Microfilms Order No. 73-12,060.

Thesis (Ph. D.).

Thin metal films of aluminum are evaporated onto substrates of poly(N-vinylcarbazole) PVK, while the substrate is held at approximately 4 K. This metal film-dielectric interface was intended as a system to test for enhanced critical temperatures due to an excitonic model of superconductivity as proposed by V. L. Ginzburg. When the critical temperatures of this system were compared to those of aluminum films on a quartz substrate it was found that the Al-PVK critical temperatures were lower than the Al-quartz critical temperatures. The critical temperatures in both cases were higher than that of bulk Al, and this enhancement could be attributed to phonon softening. No enhancement due to an excitonic pairing mechanism could be unambiguously detected. (Diss. Abstr. Int., B)

9472 JOSEPHSON EFFECT IN VARIOUS WEAK-SUPERCONDUCTOR SYSTEMS. Jahn, M. T. Stony Brook, NY; State Univ. of New York (1972). 117p. University Microfilms Order No. 73-10,905.

Thesis (Ph. D.)

Experimental studies were made of the Josephson effects in various systems, including thin film microbridges, single and composite tunnel junctions, and closely-packed superconducting powders. The results on microbridges are in good agreement with McCumber's theory on current-voltage characteristics and with the prediction by Christiansen, Hansen, and Sjostrom on temperature dependence of the critical current. The observed critical current enhancement due to microwave radiation (the Dayem effect) is about a thousand times stronger than what was predicted by Christiansen et al., assuming a linear temperature dependence of the critical current near Tc. This suggests that the Dayem effect is probably more involved than just microwave-induced locking of the phase fluctuations. The results on composite tunnel junctions allow one to set a limit on the proximity effect at the boundary between a superconductor and an insulator. In some tunnel junctions containing microshorts, "negative switching" effect was observed. Various I-V characteristics of the powder junctions were first studied in our laboratory and these new junctions are found to be very sensitive to low power microwave radiation. It is shown that powder junctions may also form a good system for studying the effect of thermal fluctuations on Josephson weak links. The results are in good agreement with the idea of phase-slippage and with a thermal noise theory by Ambegaokar and Halperin. (Diss. Abstr. Int., B)

9473 FLUX-FLOW NOISE MEASUREMENTS ON TYPE-II SUPERCONDUCTORS. Shen, S. W.; Van der Ziel, A. (Univ. of Minnesota, Minneapolis). Physica; 64: No. 3, 587-594(15 Mar 1973).

Flux-flow noise in type II superconductors is investigated experimentally. The observed noise turns out to be shot noise as expected from the assumption that the flux-flow voltage is generated by independently drifting flux bundles. Bundle sizes as large as 10^3 to 10^5 are found in vanadium foils dependent on the bias condition. The experiment shows qualitative agreement with the theory. (auth)

9474 SUPERCONDUCTIVITY AND HYSTERESIS IN INDIUM–CADMIUM ALLOYS. I. Primary Properties. Inhaber, H.; Carroll, K. J. (Univ. of Oklahoma, Norman). Physica; 64: No. 3, 508-519(15 Mar 1973).

The magnetization curves of the fcc phase of Cd in In display type II superconductivity. T_c had a sharp dropoff from $T_c \approx 3.4$ K at around 8 at. % Cd to a fairly constant $T_c \approx 3.0$ K at concentrations ≥12 at. % Cd. A number of physical quantities such as the mean free path and the electron–electron interaction strength N(0)V were found from the data. Most have an extremum around the concentration 12 at. % Cd. This may indicate a Fermi-surface-Brillouin-zone interaction near that concentration, similar to that observed in In–Cd alloys lower in Cd concentration. Since the magnetization curves showed some hysteresis, the data were adjusted to produce "reversible" curves, after the theory of Inhaber. (auth)

9475 MULTIPLY CONNECTED SUPERCONDUCTORS AND THE TUNNEL EFFECT. Baker, K.; Paterno, G.; Ricci, M. V.; Sacchetti, N.; Spagnoli, R. (CNEN, Frascati, Italy). Physica; 64: No. 3, 538-549(15 Mar 1973).

The dependence of the zero-bias differential conductance on the external magnetic field and on the quantum number n for an S–I–N tunnel junction in which the superconductor has a multiply connected geometry was computed. A new analysis of the physical properties of a type I superconducting cylinder is presented reconsidering and modifying the usually accepted approximations thus obtaining formulas with wider usefulness. (auth)

9476 INDUCTANCE OF SUPERCONDUCTING SOLENOIDS. Hirakawa, H.; Futakawa, A. (Tokyo Univ.). Cryogenics; 13: No. 5, 287-289(May 1973).

The self-inductance of a solenoid in a superconducting state is small compared with the inductance of the solenoid at room temperature. A formula for calculating the inductance of superconducting solenoids is obtained. Results of the computation are presented and compared with the experiment. (auth)

9477 MODELS OF MAGNETIC HYSTERESIS IN TYPE II SUPERCONDUCTORS. Inhaber, H. (Univ. of Oklahoma, Norman). Cryogenics; 13: No. 5, 261-271(May 1973).

The major theories of superconductivity are based on the assumption of reversible magnetization curves. Due to metallurgical and other imperfections, almost all superconductors show some degree of hysteresis. A number of theories have been proposed, on both a macroscopic and microscopic basis, to explain this phenomenon. The major theories of hysteresis, including those of Bean (Phys. Rev. Lett.; 8: 251 (1962)), Kim et al (Phys. Rev. Lett.; 9: 306 (1962) and Phys. Rev.; 129: 528 (1962)), de Jong and Blaisse (Physica; 31: 317 (1965)), and others are reviewed from the point of view of correlation with experiment. The theories of Campbell et al (Phil. Mag.; 10: 33 (1964)) and of Silcox and Rollins (App. Phys. Lett.; 2: 231 (1963)) correspond most closely to typical experimental data over a wide range of applied fields. (auth)

9478 SHORT SAMPLE TESTING OF VERY HIGH CURRENT SUPERCONDUCTORS. Purcell, John R.; DesPortes, Henri (Argonne National Laboratory, Argonne, Illinois 60439). Rev. Sci. Instrum. 44: No. 3, 295-296 (Mar 1973).

An apparatus is described for "short sample" testing at high currents using the induced current method. Primary currents of 100 A would produced up to 16 000 A secondary current. The method of measuring the secondary current and results are given. (auth)

9479 ac RESPONSE OF WEAKLY SUPERCONDUCTING STRUCTURES. Kirschman, R. K. (California Inst. of Tech., Pasadena). J. Low Temp. Phys.; 11: No. 1-2, 235-242(Apr 1973).

Measurements were made of the ac response of the Notarys–Mercereau thin-film, weakly superconducting structure. Data on the maximum constant-voltage step size and the absolute amplitude of the applied signal necessary to achieve the maximum in step size are found to be consistent with an analytical model developed for this structure. (auth)

9480 ANGULAR DEPENDENCE OF THE CRITICAL MAGNETIC FIELD IN GRANULAR SUPERCONDUCTING FILMS. Aomine, T.; Rinderer, L. (Univ., Lausanne, Switzerland). J. Low Temp. Phys.; 11: No. 1-2, 173-180(Apr 1973).

The critical magnetic field $H_c(\theta)$ of granular Al films was measured as a function of the angle θ between the field direction and the plane of the film at temperatures near T_{c0}. The film thickness d is smaller than the temperature-dependent coherence length $\xi(T)$, the "bulk" electron mean free path l is smaller than the BCS coherence length ξ_0, and $l \lesssim d$. The experimental data on $H_c(\theta)$ are well fitted by the Tinkham formula. However, the observed values of $H_{c\parallel}/H_{c\perp}$ are not always consistent with $2\sqrt{3}\xi(T)/d$ and increase with $1/d$. This fact suggests that the boundary scattering of electrons at the film surface enhances $H_c(\theta)$ and that the enhancement of $H_{c\parallel}$ is larger than that of $H_{c\perp}$. (auth)

9481 CURRENT AND CURRENT DENSITY DISTRIBUTION IN PARALLEL SUPERCONDUCTING WIRES IN A PLANAR ARRAY IN THE MEISSNER STATE. Oswald, D. (Gesellschaft AEG Telefunken, Frankfurt am Main). Cryogenics; 13: No. 5, 290-298(May 1973).

The current distribution in parallel superconducting wires is influenced by the Meissner effect. In order to treat this quantitatively, the behavior of superconducting cylinders in an inhomogeneous magnetic field was examined and the results were applied to a planar arrangement of parallel superconducting wires. How the current distribution between the conductors and the current density distribution along the circumference of each wire behave, if the distance between the conductors is varied, is also discussed, together with the effect of varying the number of wires on the current distribution. Finally the current distribution in a planar array of superconducting wires is compared with the current density distribution in a thin superconducting layer. (auth)

9482 COMPUTATION OF THE BOSON CHARACTERISTIC FUNCTION. Mancini, F. (Univ., Salerno, Italy); Umezawa, H. Lett. Nuovo Cim.; 7: No. 4, 125-128(26 May 1973).

In the boson formulation of superconductivity the boson characteristic function in momentum space is computed for small values of k and at T = 0°K. (JFP)

9483 LOCAL MOMENT SPIN RESONANCE IN A SUPERCONDUCTOR. Engel, U.; Baberschke, K.; Koopmann, G.; Huefner, S.; Wilhelm, M. (Freie Univ., Berlin). Solid State Commun.; 12: No. 10, 977-979(15 May 1973).

The ESR of Gd in $CeRu_2$ and $LaRu_2$ was observed in the normal and superconducting state. The temperature dependence of the linewidth in the superconducting state follows a trend expected from NMR measurements in superconductors. (auth)

9484 EFFECT OF IMPURITIES ON SUPERCONDUCTIVITY IN ANDERSON MODEL. Perturbational Treatment. Inoue, C.; Takano, F. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 48: No. 4, 1080-1089(Oct 1972).

The Green function for s-electrons is calculated perturbationally with respect to the mixing interaction in order to investigate the

Kondo effect in the Anderson model in superconductors. By taking the limit $U \to \infty$, it is shown that, at least to the lowest order, any singularity does not occur in the nonmagnetic case ($E \gg T$), and that the singularity in the magnetic case ($E < 0$, $|E| \gg T$) is a little different form from that of the s-d exchange model. In the nonmagnetic case, the initial decrease of superconducting transition temperature is calculated perturbationally by taking the value of U finite and the result is compared with that of the Hartree–Fock approximation. (auth)

9485 JOSEPHSON TUNNELING EFFECT IN THE SUPERCONDUCTIVITY. Zelechower, M. (Silesian Technical Univ., Katowice, Poland). Acta Phys. Pol.; A43: No. 5, 733-735(May 1973).

The Josephson tunneling current is treated as a quantum Markovian process with two states. The Kolmogorov–Schroedinger equations for this case are deduced from general theory. Since electron pairs are considered as quasibosons, a probability current is treated as a real charge current. Obtained results are somewhat more general than the well known Feynman formula because a current density differs from zero even if a value of an original phase of a wave function is equal to zero. (auth)

9486 DYNAMIC INSTABILITIES AND HYSTERETIC FLUX FLOW CURVES IN TYPE II SUPERCONDUCTORS IN THE MIXED STATE. Peltier, F. P.; Baixeras, J. (Laboratoire Central des Industries Electriques, Fontenay-aux-Roses, France). J. Phys. (Paris); 34: No. 1, 67-77(Jan 1973). (In French).

The existence was established of hysteretic flux flow curves of an inhomogeneous structured type II superconductor. A vortex displacement model is presented which, when coupled with the thermal behavior of the samples, qualitatively explains the results obtained. The model presented is based on the existence of very effective pinning sites regularly distributed in the material; the vortices are trapped by these sites and then rapidly free themselves, this phenomenon corresponding to a sudden liberation of a certain amount of energy. Some predictions of this model were experimentally verified. (auth)

9487 SUPERCONDUCTIVITY FOR RIGID BOUNDARIES. Prakash, J.; Singh, K. K. (Univ. of Delhi). Physica; 65: No. 1, 187-197(1 Apr 1973).

The theory of superconductivity in a system of interacting fermions with boundary conditions appropriate to rigid walls is discussed. By choosing an appropriate pairing, the thermodynamic potential and gap equation for the system are calculated. If one lets the dimensions of the system become infinite, the results approach those of the usual BCS theory. Application of the results to thin films is discussed. (auth)

9488 DYNAMICS OF FLUX MOTION AND AC LOSSES IN THE SUPERCONDUCTING SHEATH STATE. Wagner, J. F.; Rollins, R. W. (Physics Department, Ohio University, Athens, Ohio 45701). J. Appl. Phys. 44: No. 4, 1778-1784 (Apr 1973).

The temperature and rate dependence of the penetration of flux through the superconducting sheath is studied in the Pb–In alloy system. The waveform of the response of the sheath to a small sinusoidal magnetic field is investigated over temperature and frequency domains from $0.15T_c$ to T_c and 50 Hz to 1 kHz, respectively. The measured waveform is discussed in terms of a simple flux-creep model, a viscous flow model, and a combined flux-creep–flux-flow model The flow model assumes a distribution of pinning forces and an effective viscosity coefficient ν, both of which are taken to be independent of frequency. No distribution of pinning forces is considered in either the flux-creep or combined models. Computer analysis is employed to fit the models to the observed waveforms and to study the variation in the model parameters as a function of frequency and temperature. The simple flux-creep model does not lead to the observed frequency dependence of the sheath response, while the flow model and the combined creep–flow model are more satisfactory. However, the viscosity coefficient, η, of the latter models is found to decrease with increasing frequency. (auth)

9489 MAGNETIZATION OF HYSTERETIC SUPERCONDUCTORS FOR COMPLETE FIELD PENETRATION AND A CRITICAL-STATE MODEL WITH $J_c(H) = \alpha/H$. Ohmer, Melvin C.; Heinrich, John P. (Air Force Materials Laboratory, Solid State Materials Branch, Wright-Patterson Air Force Base, Ohio 45433). J. Appl. Phys. 44: No. 4, 1804-1809 (Apr 1973).

A critical-state model with $J_c(H) = \alpha/H$ has been developed for cylindrical geometries. It qualitatively describes the shape of magnetization curves obtained on multifilamentary superconducting wire and it accurately predicts the hysteretic loss. The size dependence of the hysteretic loss for this model is essentially the same as the Bean–London model result. However the maximum magnetization for this model is proportional to $R^{1/2}$. The temperature dependence of the hysteretic loss and α have been determined from magnetization data for NbTi wire. (auth)

9490 VARIATION OF SUPERCONDUCTING TRANSITION TEMPERATURES OF TRANSITION-METAL THIN FILMS DEPOSITED WITH THE NOBLE GASES. Schmidt, P. H.; Castellano, R. N.; Barz, H.; Cooper, A. S.; Spencer, E. G. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Appl. Phys. 44: No. 4, 1833-1836 (Apr 1973).

Thin films of Cr, Mo, Ti, W, and Zr metals deposited by dc ion–beam sputtering in noble–gas atmospheres were found to be superconducting with transition temperatures substantially higher than those observed for the respective bulk metals. Mo films deposited with a Xe ion beam were found to be superconducting at a temperature of 7.2 °K. A variation of T_c was observed for films deposited using different noble gases with highest transition temperatures obtained for deposition with Xe gas. Ion–beam–sputtered thin films of Nb, Ru, Ta, and V metals were similarly deposited with a resulting decrease in T_c as compared with their bulk metals. Film deposition with noble gases of higher mass produced higher T_c's than those obtained with lower–mass noble gases. The mechanism responsible for the variation of the superconducting transition temperatures of these metal films is not known at this time but may be associated with the formation of a dilute solution/mixture of the noble gas and the transition metal, a change in the d electron density of states at the Fermi level and a change in the Debye temperature. (auth)

9491 SURFACE LAYERS OF NB–AL COMPOUNDS ON NIOBIUM. Dickey, J. M.; Garcia, N. (Queens College of CUNY, Flushing, New York 11367); Strongin, Myron. J. Appl. Phys. 44: No. 4, 1919-1920 (Apr 1973).

Thin layers of Nb–Al compounds on a Nb substrate have been produced. An initial deposit of 200 Å of Al yielded samples with transition temperatures of 14 °K after suitable heat treatment, and it appears that Nb_3Al is formed. (auth)

Equipment and Devices

Refer also to abstracts 8863 and 8874.

9492 (AD-754082) APPLICATION OF THE SHUNTED JUNCTION MODEL TO POINT CONTACT JOSEPHSON JUNCTIONS. Taur, Y.; Richards, P. L.; Auracher, F. (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1972. Contract N00014-69-A-0200-1056. 15p. (LBL-1136). NTIS.

The dc I-V characteristics of oxidized Nb-Nb point contacts as a function of temperature, contact pressure, and rf power at 36 GHz are studied. Results for junctions which do not show hysteresis were compared in detail with calculations from the resistively shunted junction (RSJ) model first proposed by McCumber. The agreement between the data and the RSJ model, with a constant shunt resistance and including the effects of noise, is significantly better than has been reported for Dayem bridges. (auth) (NTIS)

9493 (AD-754083) MILLIMETER AND SUBMILLIMETER WAVE DETECTION AND MIXING WITH SUPERCONDUCTING WEAK LINKS. Richards, P. L.; Auracher, F.; Van Duzer, T. (California Univ., Berkeley. Dept. of Physics). Sep 1972. Contract N00014-69-A-0200-1056. 54p. NTIS.

A weak link between two bulk superconductors can exhibit Josephson effects and can be used as a fast, sensitive detector or mixer for electromagnetic radiation. Emphasis is placed on the millimeter and submillimeter range where such applications are potentially most important, though such devices should also work well at lower frequencies. The peculiar properties of the weak link make possible a variety of modes of operation including one in which it is both local oscillator and mixer. These modes of operation are analyzed and the pivotal experiments are reviewed. Noise and impedance matching are considered and comparison is made with other types of detectors of millimeter and submillimeter waves. (auth) (NTIS)

9494 (JINR-P8-6987) INVESTIGATION OF THE SHORT TERM DIELECTRICAL STRENGTH AND THE SERVICE TIME OF MYLAR INSULATION UNDER CRYOGENIC CONDITIONS. Anishchenko, N. G.; Minein, V. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 8p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

A setup to investigate the short and long term electrical strength of different dielectrics and of the elements of superconducting devices in the medium of gaseous and liquid nitrogen and helium is described. A significant scatter of the values of breakdown voltage stress (E) of two and especially one layer of a 10 μ mylar film was observed that is explained, evidently, by the presence of local film defects. At an a.c. voltage of 50 cps the short term electrical strength of two mylar layers was 240 ± 80 kV max/mm for all the range of studied cryogenic medias, at a d.c. voltage—460 ± 90 kV/mm. The velocity of increasing the voltage was smooth and could be equal to any value in the range of 0.15 + 2.7 kV/sec. Par-

tial discharges were observed which sometimes achieved 10^{-5} Coulomb. The long term electrical strength of the mylar film during the tests at 50 cps in liquid helium can be characterized by the voltage-time-to-breakdown curve ("curve of life"), i.e., by the dependence $\lg \tau = f(\lg E)$, where τ is the service time of the insulation. In the investigations on aging the range of breakdown voltage stress was from 200 up to 400 kV max/mm, the service time—up to 70 min. Under conditions of the performed experiments at 200 kV max/mm a sharp increase of the film service time was observed. The dependence of the partial discharges intensity upon that of the electrical field taken during the tests on the mylar aging is also presented. It is concluded that the mylar isolation "ages" in the inert medium of the liquid helium. (auth)

9495 NONLINEAR STABILITY PROBLEMS FOR THE SINE-GORDON EQUATION. Callegari, Andrew J.; Reiss, Edward L. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). J. Math. Phys. (N.Y.) 14: No. 2, 267-276 (Feb 1973).

Two stability problems for the nonlinear sine–Gordon equation are studied. The stability of a class of time independent (static) solutions is studied using linear dynamic stability theory. An asymptotic approximation of the nonlinear transient response to small disturbances of an unstable static state is obtained by the two time method. Interpretations of the results are given for the continuous pendulum problem and for the Josephson tunnel junction. A proof of the validity of the asymptotic approximation is given. (auth)

9496 INFLUENCE OF SELF-FIELD EFFECTS ON THE TEMPERATURE DEPENDENCE OF THE JOSEPHSON SUPERCURRENT. Halse, M. R.; Salleh, K. M. (Univ. of Kent, Canterbury, Eng.). J. Low Temp. Phys.; 11: No. 1-2, 210-214(Apr 1973).

The temperature dependence of the Josephson supercurrent was measured in a number of blob junctions formed between Nb–Zr wire and Pb–Sn solder. In favorable cases the critical current is found to increase periodically with decreasing temperature. The effect is due to the self-field generated by current flow in an asymmetric double junction. Interchanging the current and voltage leads alters the geometry of such a junction and hence alters the periodicity. (auth)

9497 SMALL ^{3}He CRYOSTAT FOR SINGLE CRYSTAL NEUTRON DIFFRACTION APPLICATIONS WITH A NEW THERMOMETER CALIBRATION TECHNIQUE. Starr, E. F. Jr. Columbus, OH; Ohio State Univ. (1972). 108p. University Microfilms Order No. 73-11,582.

Thesis (Ph.D.).

The desire to conduct single crystal neutron diffraction experiments in the 0.3 to 2.0°K temperature region created the requirement for a cryostat capable of operating in this temperature region. Additional requirements for this cryostat are small size and weight, a minimum of ancillary equipment, and a reasonable degree of portability. The design and construction details and performance characteristics of such a cryostat, as well as the application and results of a new thermometer calibration technique, are reported herein. The final cryostat is a four-stage device with a liquid ^{4}He stage and liquid ^{3}He stage being added to a commercial two-stage Joule–Thomson heat exchanger. The Joule–Thomson unit operates on high pressure N_2 and H_2 gas and thus provides liquid nitrogen and liquid hydrogen stages. A unique feature of this cryostat is that a charcoal adsorption pump is utilized to pump the ^{3}He stage. This adsorption pump is built into the ^{4}He stage and, since the ^{3}He gas reservoir is also a physical part of the cryostat, the ^{3}He system is completely closed and an integral part of the cryostat. The calibration results for three carbon resistors is reported and a discussion of thermometer equations is presented. The final cryostat is 60 cm long with a maximum diameter of 7.6 cm. The basic cryostat weighs less than two kilograms. The cryostat can be mounted on a General Electric crystal orienter and can be moved from one physical location to another without undue difficulty. The operation of the cryostat requires approximately 12 hours cool-down time. Temperatures in the 0.3 to 0.4°K region can be maintained for periods of six hours or more. The complete operating procedure and performance of the cryostat are detailed as a part of this work. (Diss. Abstr. Int., B)

9498 A DESORPTION CRYOSTAT FOR EXPERIMENTS FROM 1.5–120 K. Naugle, D. G.; Adair III, T. W.; Maddox, J. E. (Department of Physics, Texas A&M University, College Station, Texas 77843). Rev. Sci. Instrum. 44: No. 4, 422-424 (Apr 1973).

A large desorption cryostat particularly suited for measurement of the properties of cryogenic materials between 1.5 and 60K is described. In the difficult range above 20K temperature control and uniformity remains excellent. For measurements above 20K either hydrogen or helium may be used as the adsorptive. The temperature range of the cryostat may be extended to 120K with the use of nitrogen as the adsorptive. (auth)

9499 A SUPERCONDUCTING SUSPENSION WITH VARIABLE RESTORING FORCE AND LOW DAMPING. Hebard, Arthur F. (Department of Physics, Stanford University, Stanford, California 94305). Rev. Sci. Instrum. 44: No. 4, 425-429 (Apr 1973).

A technique for the magnetic suspension of small (< 1 mm diam) superconducting niobium spheres is described in which the restoring forces (shape of the applied field) can be conveniently adjusted and low losses in the translational modes of oscillation easily obtained. The suspension was developed for use in an experiment designed to detect the existence of fractional electric charge but is applicable to other experimental situtations as well. A typical sphere is suspended with a vertical period of oscillation of 1.5 sec and a Q of 3000. Adjustments can be made over the period range 0.6 to 9 sec and Q's as high as 8000 have been achieved. (auth)

9500 FLUX-QUANTIZATION EFFECTS IN LARGE INDUCTANCE LOOPS CONTAINING JOSEPHSON JUNCTIONS. Guéret, P. (IBM Zurich Research Laboratory, 8803 Rüschlikon, Switzerland). J. Appl. Phys. 44: No. 4, 1771-1773 (Apr 1973).

Computer simulations of a flip–flop circuit containing weak links (Josephson junctions) show that extremely small changes in the circuit inductance can lead to drastic differences in the circuit behavior. The effect, which is explained in terms of flux quantization, is not limited to small inductance loops, but is also observable in loops which can contain a large number of flux quanta. It is of importance in connection with the punch-through phenomenon recently reported by Fulton and Dynes. (auth)

9501 OBSERVATIONS ON ELECTRON LOADING IN SUPERCONDUCTING CAVITIES. Kneisel, P.; Stoltz, O.; Halbritter, J. (Institut für Experimentelle Kernphysik, Universität and Kernforschungszentrum, Karlsruhe, Germany). J. Appl. Phys. 44: No. 4, 1785-1788 (Apr 1973).

Electron loading has become a severe drawback for the high–field application of good superconducting cavities. In this paper we have analyzed different experimental forms of electron loading. We found both qualitatively new forms of resonant trajectories causing multipactor barriers and multipactor barriers at electron impact energies, where clean metal surfaces would give no gain of electrons. (auth)

9502 PROXIMITY EFFECT BRIDGE AND SUPERCONDUCTING MICROCIRCUITRY. Notarys, H. A.; Mercereau, J. E. (California Institute of Technology, Pasadena, California 91109). J. Appl. Phys. 44: No. 4, 1821-1830 (Apr 1973).

Techniques have been developed with which it is possible to fabricate superconducting thin–film structures with a wide variety of electrical and superconducting parameters which show Josephson–like phenomena. These bridges—based on the proximity effect—are made in layered thin–film "substrates" using a large variety of superconducting and nonsuperconducting materials. In this paper we detail the fabrication techniques and the electrical and superconducting characteristics for these proximity effect bridges including a simple low–frequency (< 10 GHz) equivalent circuit based on analysis and experiment which closely describes the quantum phase coherence operation of the bridges in their voltage sustaining state. Extension of these fabrication techniques to entire thin–film electrical circuits including resistors, capacitors, and inductors with these bridges and leading to an entire superconducting microcircuit technology is discussed. (auth)

9503 PHOTOSENSITIVITY IN SUPERCONDUCTING TUNNEL JUNCTIONS WITH A CADMIUM SELENIDE BARRIER. Rissman, Paul (Department of Electrical Engineering, University of Wisconsin, Madison, Wisconsin 52706). J. Appl. Phys. 44: No. 4, 1893-1894 (Apr 1973).

Photosensitivity is observed in superconducting tunnel junctions with a cadmium selenide barrier. This supports the conclusion that the important factor in determining photosensitivity is the predominance of trap levels of only one type, in this case hole trap levels. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 9670, 9903, and 10019.

9504 (AD-753329) ANTI: A SCALING CODE FOR NEUTRON TRANSPORT THROUGH THE ATMOSPHERE. Bevelock, J. G.; Rhinesmith, R. (Picatinny Arsenal, Dover, N. J.). Aug 1972. 31p. (PA-TM-2019). NTIS.

ANTI is a computer program which uses existing transport data given at sea level to determine the energy spectrum of neutrons transported from a given source to a receptor. As an option, the program can list in a convenient format the complete set of transport data built into the program and also the transport data at the equivalent sea level distance between the given source and receptor. (NTIS)

9505 (CONF-721018-21) COMPARISON OF ONE AND TWO DIMENSIONAL DISCRETE ORDINATE CALCULATIONS WITH EXPERIMENTAL RESULTS. Fuse, T.; Yamaji, A.; Miura, T. (Ship Research Inst., Tokai (Japan)). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Neutron transport studies in a water medium and in a cylindrical air duct in a water medium were performed. The calculations were carried out with the neutron transport codes ANISN and PALLAS-SP for a one-dimensional spherical geometry, and with the PALLAS-CY program for a two-dimensional geometry. The experiments were performed in the water shield of a pool type reactor JRR-4. Measurements were made using the activation method. The reaction rates were obtained by calculation and compared with the experimental results. The agreement appears to be fair. (FR)

9506 (JAERI-M-4721) MCROSS-2: A CODE FOR CALCULATION OF MICROSCOPIC AND EFFECTIVE CROSS SECTIONS. Takano, H. (Japan Atomic Energy Research Inst., Tokyo). Mar. 1972. 33p. (In Japanese). INIS.

The code MCROSS-2 is for calculating the microscopic and effective cross sections. The microscopic cross sections can be calculated by either the multi-level or the Breit–Wigner single-level formula. For the former formula, Vogt's or Takano's fitting parameters have to be introduced. Microscopic cross sections are calculated for the energy or lethargy mesh points. From the microscopic cross sections calculated, the effective cross sections are obtained under the assumption of constancy of the collision densities. (auth)

9507 (JINR-P4-7055) REFLECTION OF ULTRACOLD NEUTRONS FROM ROUGH SURFACE. Roughness Effect on Absorption Coefficient. Ignatovich, V. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The effect of roughness, small in comparison with the depth of penetration, on the absorption coefficient and angular distribution of reflected ultracold neutrons (UCN) is theoretically considered. The interpolation formula is obtained describing the dependence of the UCN absorption coefficient on the parameters of the surface roughness in the whole region of their change. (auth)

9508 (LA-5277-MS) SPECIFICATION OF A GENERALLY USEFUL MULTIGROUP STRUCTURE FOR NEUTRON TRANSPORT. Weisbin, C. R.; LaBauve, R. J. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

The work of a committee appointed and directed by the Codes and Formats Subcommittee of the Cross Section Evaluation Working Group, parallel to that already completed for the thermal range, is reported. It is an attempt to suggest reasonable energy bounds, weighting function and output format for a "standardized" multigroup library in the fast energy range (>1 eV) to be prepared for general distribution. Although the emphasis is clearly directed toward the LMFBR program, the large number of groups (~250) made it possible to include the majority of CTR, shielding, and weapons requirements with the notion that a problem-dependent group structure can be obtained conveniently at run time by a simple collapsing procedure. The new structure is compatible with past design experience and incorporates detailed representation for specific cross section features known to be important in a wide range of nuclear design applications. (2 figures, 1 table) (auth)

9509 (LA-UR-73-517) TRANSPORT THEORY NUMERICAL METHODS. Lathrop, K. D. (Los Alamos Scientific Lab., N. Mex.). 1972. Contract W-7405-eng-36. 10p. (CONF-730414-3). Dep. NTIS $3.00.

From national topical meeting on mathematical models and computational techniques for analysis of nuclear systems; Ann Arbor, Michigan, USA (8 Apr 1973).

The papers in the session "Numerical and Computational Aspects of Transport Theory" are discussed within the context of a review of new developments in five areas of transport theory numerical solution methods. The "variable Eddington factor," anisotropic diffusion coefficient, and generalized diffusion equation methods, which seek to obtain transport accuracy by solving the simpler diffusion equation, are compared. The lack of research in the solution of the spherical harmonics equations is noted. The great promise of finite-element methods is described, particularly in situations where nearly direct inversion of coefficient matrices is possible. Methods based on solution of the integral equation are compared, and the attractiveness of interface-current techniques which couple only adjacent cells is emphasized. The advantages and disadvantages of Monte Carlo methods are reviewed, and the potential of the related phase-space-time-evolution method to overcome the statistical problems of Monte Carlo is discussed. It is judged that finite-element and interface-current techniques offer the greatest potential for providing cheap and accurate numerical solutions of the transport equation. (auth)

9510 (USNDC-3, pp 93-97) INTEGRAL EXPERIMENTS TO TEST GAMMA-RAY PRODUCTION AND NEUTRON SCATTERING CROSS SECTIONS OF CARBON AND NITROGEN. Harris, L.; Young, J. C.; Trimble, G. D. (Gulf Radiation Technology, San Diego, CA). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9511 (USNDC-3, pp 133-134) AGE TO INDIUM RESONANCE IN WATER FOR ^{252}Cf NEUTRONS. Spiegel, V. (National Bureau of Standards, Washington, DC). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9512 EXPERIMENTALLY DETERMINED TISSUE AIR RATIOS AND SCATTER AIR RATIOS FOR COLLIMATED BEAMS OF 14-MeV NEUTRONS. Beach, J. L. Madison, WI; Univ. of Wisconsin (1972). 147p. University Microfilms Order No. 73-7177.

Thesis (Ph. D.).

Tissue air ratios (TAR) and scatter air ratios (SAR) for collimated beams of 14 MeV neutrons were determined from depth dose curves measured in air and water using a tissue equivalent proportional counter. Central axis depth dose data were obtained as a function of field size and depth in a water phantom for an SSD of 125 cm. The collimator consisted of two sets of jaws constrained to move in arcs centered on the target edges and was continuously variable from a 3 × 3 cm to a 20 × 20 cm field size at 125 cm SSD. Each collimator jaw was 50 cm thick with 30 cm of steel followed by 20 cm of polyethylene. Addition of a 5 cm thick steel field trimmer served to minimize the difference in penumbra between vertical and horizontal beam profiles and produced field scans that were flat to within ±1% over 80% of the field dimension and were reduced to 20% of the central axis dose at 1.2 field radii in air. Initial investigations were made using an NE 102 plastic scintillator, taking advantage of the high counting rate to optimize the collimation and experimental procedures. The proportional counter used in these experiments was a ½" diameter LET counter manufactured by EG&G which utilized inherent gamma discrimination capabilities to measure the absorbed dose due to neutron interactions with LET ranging from about 4 to 100 keV/μ. Depth dose data in air and phantom were measured with a precision of ±2% and were smoothed before the TAR and SAR calculations were made. The scatter air ratios measured for 14 MeV neutrons have roughly the same characteristics as cobalt 60 SAR but are almost twice the magnitude at all depths and reach a maximum at about 60% of the peak depth for cobalt for all field sizes. The effects of collimator throat scatter on the central axis depth dose characteristics are discussed in detail using the measured tissue and scatter air ratios for 14 MeV neutrons. (Diss. Abstr. Int., B)

9513 CALCULATION OF THE ANISOTROPIC DIFFUSION COEFFICIENT. Takeda, T.; Sekiya, T. (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 12, 697-704(Dec 1972).

The one-group anisotropic diffusion coefficient is calculated for slab and square lattice cells with use made of Benoist's formula. In utilizing the integral transport theory, only several collisions suffered by a neutron have hitherto been considered. One adopts the integral theory and takes into consideration the effect of an infinite number of collisions suffered by a neutron, this being made possible by solving simultaneous equations. Further, one considers the anisotropic scattering through the generalized first-flight collision probability. Then one estimates the fundamental and the additional terms in the Benoist formula for slab and square lattice cells. (auth)

9514 CONVERGENCE IN THE MEAN OF SOLUTIONS TO THE NEUTRON INTEGRAL BOLTZMANN EQUATION IN THREE-DIMENSIONAL SYSTEMS. Boffi, V. C. (Laboratorio di Ingegneria Nucleare dell Università di Bologna, Bologna, Italy); Premuda, F.; Spiga, G. J. Math. Phys. (N.Y.) 14: No. 3, 346-352 (Mar 1973).

The Neumann series solution as well as practical solutions for the stationary integral Boltzmann equation, which governs the flux distribution of monoenergetic neutrons in a three-dimensional system made by an isotropically scattering and multiplying material, are built up by extensively using the concept of double norm and the theory of bounded linear integral transformations in a Lebesgue space L_p. The convergence in the mean as well as other basic properties of the proposed solutions are studied for the cases of both distributed and isotropic deltalike sources. (auth)

9515 SENSITIVITY OF NEUTRON TRANSPORT CALCULATIONS TO NONELASTIC NEUTRON ANGULAR DISTRIBUTIONS. Plechaty, E. F. (Univ. of California, Livermore). Nucl. Sci. Eng.; 51: No. 2, 239-242(Jun 1973).

Practical considerations of computer capacity may force an artificial reduction of evaluated neutron data sets. The calculation of the first collision distribution as a function of energy and angle is an important aid in deciding which data can be removed without altering the evaluation in a significant manner. (7 figures, 3 tables) (auth)

9516 APPLICATION OF PHASE-SPACE FINITE ELEMENTS TO THE ONE-DIMENSIONAL NEUTRON TRANSPORT EQUATION. Miller, W. F. Jr.; Lewis, E. E.; Rossow, E. C. (Northwestern Univ., Evanston, IL). Nucl. Sci. Eng.; 51: No. 2, 148-156(Jun 1973).

The finite-element method is applied to the one-dimensional neutron transport equation. Piecewise bilinear or trilinear polynomials that are continuous in the space-angle phase space are utilized in an even-parity functional for the angular flux to establish linear simultaneous sets of algebraic equations. Both inhomogeneous and eigenvalue problems in slab, spherical, and cylindrical geometries are treated. The application of the finite-element method to problems with anisotropic scattering and material interfaces is also demonstrated. In all cases, the accuracy of the finite-element results is an improvement over that obtained from standard S_N calculations using comparable numbers of simultaneous equations. (4 figures, 6 tables) (auth)

9517 MONTE CARLO CALCULATION OF NEUTRONS TRANSMITTED THROUGH MATTER. Hirayama, H.; Nakamura, T. (Kyoto Univ.). Mem. Fac. Eng., Kyoto Univ.; 34: No. 2, 187-200(Apr 1972).

The neutron Monte Carlo code CYGNUS, which is written in Fortran IV, is described. This code can easily be used for several limited geometries, and requires considerably less computing time than O5R. In this paper, two methods of calculation are described, a weight method and a collision density method; the two techniques for determination of the anisotropic scattering angle in the center-of-mass system, i.e., Legendre expansion and Coveyou technique, and the method for determination of the excited level in inelastic scattering are also described. The results calculated with the CYGNUS code are compared with the numerical solution by the PALLAS code for the scalar flux in water and graphite spheres, and with experimental spectra for the angular neutron flux in water and iron shields. The agreement obtained between the CYGNUS calculations and numerical or experimental results is good. (auth)

9518 SOBRANIE NAUCHNYKH TRUDOV. I. Fizika Nizkikh Temperatur. Neitronnaya Fizika. (Collected Scientific Works. Volume I. Low-Temperature Physics. Neutron Physics). Pomeranchuk, I. Ya. Moscow; Izdatel'stvo Nauka (1972). 360p.

This volume contains 33 papers on the theory of metals, properties of dielectrics, Bose and Fermi liquids, and neutron scattering and absorption, all authored by Pomeranchuk or jointly with coworkers from 1936 to 1963. (KSW)

9519 EFFECT OF REENTRANT HOLE PERTURBATION ON ANGULAR THERMAL NEUTRON SPECTRA IN TIME OF FLIGHT MEASUREMENT. Akino, F.; Kaneko, Y. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 1, 45-53(Jan 1973).

The effect of the presence of a reentrant hole for extracting the neutron beam from within experimental systems of two different geometries is analyzed theoretically by using multi-group 2-dimensional discrete S_n method without resorting to bold assumptions for neutron transport or drastic simplification of geometry. One of the two experimental systems is a rectangular light water prism 12 cm high of 40×40 cm^2 cross section, poisoned with Cd and/or In, and provided with a 1-, 2-, or 3-cm-diameter reentrant hole. The other system is a 1'' thick natural uranium plate sandwiched between two layers of pure light water, each 4.6 cm thick, which also is provided with a 1-cm-diameter reentrant hole. The following is concluded by comparing the angular neutron flux with and without the reentrant holes. With the first experimental system, perturbations of the order 10 to 25% are caused, which are particularly strong below about 0.3 eV, except when the hole diameter is 1 cm. The perturbation effect increases as the reentrant hole becomes larger in diameter and shallower in depth. In the case of the second experimental system, the effect results in about 2% increase of the neutron flux at the bottom of the reentrant hole when the bottom is located in the natural uranium plate. On the other hand, if the bottom is in the light water region, the neutron flux is reduced by about 2 to 4% at the peak of the thermal neutron spectra. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 9327, 9537, 9539, and 9627.

9520 (AECD/TP-31) DOES AN L-INDEPENDENT $\alpha-\alpha$ INTERACTION EXIST. Rahman, M.; Ali, S.; Afzal, S. A. (Atomic Energy Centre, Dacca (Pakistan)). Sep 1972. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

An analysis of $\alpha-\alpha$ elastic scattering data up to bombarding energies of 24 MeV made with Woods–Saxon potential reveals two very simple but hitherto unnoticed features of the low energy $\alpha-\alpha$ interaction namely that the l dependence of the $\alpha-\alpha$ interaction is not a must and that the existence of a repulsive part in the $\alpha-\alpha$ interaction over and above the Coulomb potential is not indispensable. Both these findings contradict past investigations and seem to point towards the possible existence of a static $\alpha-\alpha$ interaction. (auth)

9521 (AECD/TP-32) SCATTERING FROM NONLOCAL, NONSEPARABLE POTENTIAL AND n + α PHASE SHIFT. Chowdhury, S.M.M.R.; Suhrabuddin, S. (Atomic Energy Centre, Dacca (Pakistan)). Sep 1972. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

An exact analytical expression for partial-wave phase shifts is obtained for non-local non-separable potential for which numerical approximation is generally used and it is shown that the results thus obtained can be reduced to those of non-local separable potential. It is found that the experimental phase shifts δ_0 of n + α scattering for wide range of energies can easily be reproduced if the interactions between n and α is assumed to be of Yukawa type non-local non-separable ones with energy independent parameters. The equivalent local potential for this non-local interaction shows short range repulsion and has the same characteristics as that of nucleon–nucleon potential. (auth)

9522 (JINR-E1-7024) SMALL ANGLE π^- ^{4}He ELASTIC SCATTERING AT 3.48 AND 6.13 GeV/c. Nomofilov, A. A.; Sitnik, I. M.; Slepets, L. A.; Strunov, L. N. (Joint Inst. For Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. Dep. NTIS (U. S. Sales Only $3.00.

The π^- ^{4}He elastic scattering differential cross sections were measured in the range of the small squared four-momentum transfers of $0.0056 \leq |t| \leq 0.087$ and $0.0056 \leq |t| \leq 0.0462$ (GeV/c)^2 at 3.48 and 6.13 GeV, respectively. The data were analyzed by the Glauber theory. The slope parameter of the spin-independent differential cross sections of the πN elastic scattering was obtained. The slope parameter of the diffraction cone, the total π^- ^{4}He elastic scattering cross section and the equivalent radius of the ^{4}He nucleus were also determined. (auth)

9523 (JINR-E2-6962) POSSIBILITY OF DETERMINATION OF THE COUPLING CONSTANT π^- ^{3}He ^{3}H. Dumbrais, O. V.; Nichitiu, F.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Re-

search, Dubna (USSR). Lab. of Nuclear Problems). 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of determination of the $\pi^- {}^3He {}^3H$ coupling constant on the basis of the existing experimental data on the differential cross section of the $\pi^+ {}^3He$ scattering at 100 MeV was investigated. The method is based on the extrapolation of $d\sigma/d\Omega$ to the ${}^3H^-$ pole exploiting the conformal mapping techniques. The accuracy of the existing data is insufficient for the estimation of the magnitude of this coupling constant. (auth)

9524 (ORO-4043-10) EXPERIMENTS ON THE NUCLEAR INTERACTIONS OF PIONS. Progress Report, September 1, 1972 – August 31, 1973. McCarthy, J. S.; Minehart, R. C.; Sobottka, S. E.; Ziock, K. O. H. (Virginia Univ., Charlottesville). 1973. Contract AT(40-1)-4043. 248p. Dep. NTIS $14.50.

Data on pion absorption in ^4He reveal the importance of the neutron–neutron final state interaction. The data were taken for the experiment on pion absorption in ^3He. The measured (π^+, p) cross sections for ^6Li, ^8Be, ^{12}C and ^{16}O are generally smaller than those expected with a distorted wave impulse approximation. A plane wave impulse approximation fits the (π^+, 2p) data for ^6Li, but not for ^{14}N and ^{16}O. The data from the pion scattering experiment on ^{40}Ca are compared with optical model calculations. The LAMPF experiments on pion scattering from deuterium, and pion absorption with cluster emission, are in the final stages of preparation. Proportional chambers with monofilar helical cathodes for high resolution position measurements in the EPICS spectrometer were developed. Also proportional chambers with folded transmission line anodes for simultaneous delay line readout of two coordinates were developed. Studies of beam monitoring on the LAMPF pion channels and the construction of the detectors and electronics for EPICS were continued. Also one was chairman of the EPICS and Low Energy Pion Channel Working Groups and member of the LAMPF Technical Advisory Panel and Board of Directors. (auth)

9525 (USNDC–3, p 120) NEUTRON SOURCE REACTION: $^3T(p,n)^3He$. Hopkins (Los Alamos Scientific Lab., NM); Martin; Seagrave; McDaniels; Drosg. 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9526 (USNDC-3, pp 155; 159-161) TOTAL NEUTRON CROSS SECTION OF DEUTERIUM FROM APPROXIMATELY ZERO TO 1000 keV. Stoler, P.; Kaushal, N. N.; Green, F. (Rensselaer Polytechnic Inst., Troy, NY). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9527 MEASUREMENT OF THE SPIN CORRELATION PARAMETERS A_{yy} AND A_{xx} OF PROTON–PROTON SCATTERING AT 47.5 MeV. Hasegawa, T. (Kyoto Univ.); Horikawa, N.; Saito, M.; Nakanishi, T.; Nishimura, K. J. Phys. Soc. Jap.; 33: No. 4, 871-880(Oct 1972).

The measurement of the spin correlation parameters of proton-proton scattering at 47.5 MeV has been done by using polarized beam and polarized target. A proton beam which had 50% polarization was provided by p-Ca scattering. The polarized target was a LMN crystal which was maintained at 35% polarization by dynamic method during the experiment. The spin correlation parameters A_{yy} and A_{xx} at 90°C_{CM} were measured simultaneously. A_{yy}, A_{xx} and A_{yy}/A_{xx} at 47.5 MeV were -0.287 ± 0.039, -0.713 ± 0.032 and 0.402 ± 0.057, respectively. (auth)

9528 THREE-BODY FORCE IN TRITON. Yang, S. N. Stony Brook, NY; State Univ. of New York (1972). 77p. University Microfilms Order No. 73-10,895.

Thesis (Ph. D.).

A two-pion-exchange three-body potential was derived by using a chiral-invariant Lagrangian for the pion–nucleon scattering. There are three dominant processes which give rise to a three-body interaction: (a) the second pion is emitted before the first pion is absorbed and the nucleon which emits the second pion goes into a positive-energy state; (b) one nucleon exchanges a ρ meson with a pion; (c) one nucleon scatters into N*(1236). The contribution of this three-body potential to the binding energy of the triton is then evaluated by using a good triton wave function. It is found that the three-body potential gives a significant contribution (of order 2 MeV) to the binding energy of the triton. (Diss. Abstr. Int., B)

9529 THEORETICAL STUDY OF THE BOUND THREE-NUCLEON SYSTEM. Harper, E. P. Lafayette, IN; Purdue Univ. (1972). 178p. University Microfilms Order No. 73-6038.

Thesis (Ph. D.).

A complete angular momentum reduction of the Faddeev equations for the case of realistic, nonrelativistic three-nucleon systems with (local and/or nonlocal) interactions having general spin, isospin and velocity dependence. Antisymmetrization of states with respect to particle exchange is properly accounted for by using the isospin formalism. Expressions for the Faddeev equations, in the form of coupled two-variable integral equations, are obtained in the L–S coupling scheme. Using the solutions to these equations (Faddeev amplitudes), general formulas are developed for constructing the bound state wave function. For trinucleon systems with nucleon-nucleon interactions in the $^1S_0$ and $^3(S-D)_1$ states only, the complete set of homogeneous Faddeev equations is solved and formulas for constructing the wave function are given. This wave function is classified according to the Blatt–Derrick scheme. The Reid soft-core potential and unitarily equivalent rank-two transformations of it are used to represent the N-N interaction. The tri-nucleon binding energy is found, using the Reid potential, to be 6.75 MeV. The phase-equivalent potentials have a small effect on this binding energy but tend to decrease rather than increase it. Using the wave functions, corresponding to the various phase-equivalent potentials, that are obtained from the Faddeev equations ^3He and ^3H charge and magnetic moment form factors and electromagnetic root mean square radii are calculated. The calculated form factors, in all cases agree with the experimental data at low values of Q^2 (momentum transfer squared). At higher momenta the diffraction structure found experimentally in the ^3He charge form factor is obtained but is not in quantitative agreement with experiment. Using the Reid potential a minimum at $Q^2 = 15.5\ F^{-2}$ is obtained, whereas the experimental minimum occurs at $Q^2 \sim 11.8\ F^{-2}$. The phase-equivalent transformations do not improve the situation very much as far as agreement with experiment is concerned. Finally, the wave function obtained from the calculation using the Reid potential is used to calculate the one-pion-exchange contribution to the axial-vector matrix element for the decay $^3H \rightarrow {}^3He + e^- + \bar{\nu}$, and the two-nucleon one-pion-exchange contributions to the isovector and isoscalar trinucleon magnetic moments. The former calculation indicates that some amendment to the meson exchange theory might be needed while the latter very nearly accounts for the existing discrepancies between the theoretical and experimental trinucleon magnetic moments. (Diss. Abstr. Int., B)

9530 NEUTRON POLARIZATION FROM THE $D(d,n)^3He$ AND $^9Be(d,n)^{10}B$ REACTIONS. Spalek, G. C. Durham, NC; Duke Univ. (1972). 117p. University Microfilms Order No. 73-6598.

Thesis (Ph. D.).

Accurate neutron polarization angular distributions from the $D(d,n)^3He$ reaction were measured at 6, 8, 10, 12 and 14 MeV. The results show large polarizations near 45° c.m. increasing from a value of 0.13 at 6 MeV to 0.44 at 14 MeV. A shift of the peak polarization from 45° cm toward 40° cm as the energy increases is also seen. Comparison of the obtained polarization distributions with those from the D(d,p)T reaction shows that the neutron polarizations are consistently smaller up to 12 MeV. The implications of this with respect to the concept of charge symmetry of nuclear forces are discussed. In addition the usefulness of the $D(d,n)^3He$ reaction as a source of polarized 8 to 15 MeV neutrons is also discussed. Polarization angular distributions were measured for the five most energetic neutron groups from the $^9Be(d,n)^{10}B$ reaction at 3 and 3.5 MeV bombarding energies. All these transitions involve the transfer of an $l_p = 1$ proton. A decrease in structure of the polarization distributions with increasing excitation of the residual nucleus was observed at both energies. At angles less than 50° cm the n_0 group polarization becomes more negative with increasing energy and there is evidence that the $j_p = 1/2$ transfer component of the n_1 group polarization is positive. Cross sections for $^9Be(d,d)$ elastic scattering were obtained and optical model parameters extracted. Agreement between DWBA calculations using these parameters and $^9Be(d,n)$ polarization and cross section data was minimal. In particular, the j dependence of the neutron polarization was not reproduced. Reasons for the above are discussed. (Diss. Abstr. Int., B)

9531 TOTAL NEUTRON CROSS SECTIONS OF HYDROGEN AND DEUTERIUM IN THE MeV REGION. Clement, J. M. Jr. Troy, NY; Rensselaer Polytechnic Inst. (1973). 140p. University Microfilms Order No. 73-7388.

Thesis (Ph. D.).

A measurement of the total neutron cross sections of hydrogen and deuterium were performed at the R.P.I. Linear Accelerator using a white source and time of flight techniques. High purity gaseous samples were used to induce uniformity and known sam-

ple thickness. The pulsed neutron source (20 nsec) combined with a long flight path (250 m) assured excellent geometry and resolution (0.1 nsec/m). The deuterium data consist of 431 points with statistical accuracy of 0.3 to 1.3% from 0.5 to 15 MeV, 2% at 20 MeV, and 5% at 29 MeV. The hydrogen results consist of 424 points with 0.5 to 3% statistical accuracy from 0.5 to 15 MeV, 7% at 20 MeV. The absolute accuracy of the final cross sections is better than 1% with no more than 0.2% energy scale error. This makes the current deuterium measurements about an order of magnitude more precise than previous measurements. In particular the 5% discrepancy from 3 to 8 MeV between previous deuterium measurements has been resolved. The hydrogen cross section lies within 1% of most recent measurements. If any structure exists in either cross section it must be smaller than 20 mb. (Diss. Abstr. Int., B)

9532 ATOMIC MASSES OF MASS-SUBSTANDARDS H, D, ^{35}Cl, AND ^{37}Cl, AND OF ^{14}N, ^{16}O. Katakuse, I. (Osaka Univ., Toyonaka, Japany). Shitsuryo Bunseki; 20: No. 4, 255-279(Dec 1972).

In order to determine the atomic masses of the mass-substandards, H, D, ^{35}Cl and ^{37}Cl, the ten kinds of doublets involving these nuclides were measured by the digital peak matching method with the half height resolution of 300,000 to 500,000. These doublet mass differences were as follows: $(C_2D_6-C_3)$ = 84,611.600 ± 0.340, $(C_2D_6-H^{35}Cl)$ = 107,934.900 ± 0.540, $(C_3-H^{35}Cl)$ = 23,321.830 ± 0.630, $(C_2D_6-C_3)$ = 84,611.730 ± 0.411, $(C_3-H^{35}Cl)$ = 23,322.328 ± 0.325, $(C_2D_6-H^{35}Cl)$ = 107,933.422 ± 0.538, $(C_3H_2-H^{37}Cl)$ = 41,922.176 ± 0.305, $(D^{35}Cl-^{37}Cl)$ = 17,051.816 ± 0.185, $(C_2D_2-C_2H_4)$ = 3,096.444 ± 0.127 and $(C_3H_8-C_3D_4)$ = 6.192 ± 0.265 μu. By using above doublet mass difference values as input data, the mass-substandards were calculated by least squares treatments. The results were H = 7,825.065 ± 0.030, D = 14,101.930 ± 0.040, ^{35}Cl = −31,147.21 ± 0.20 and ^{37}Cl = −34,097.10 ± 0.22 μu. By using these results and the previously measured doublets $(C_2H_4-^{14}N_2)$ = 25,152.44 ± 0.19 and $(C_2H_4-C^{16}O)$ = 36,384.01 ± 0.24 μu, mass excesses of ^{16}O = −5,085.75 ± 0.25 and ^{14}N = 3,073.91 ± 0.14 μu were obtained. (auth)

9533 SEMI-PHENOMENOLOGICAL ANALYSIS OF THE ^{2}H(α,αp)n REACTION. Nakamura, H. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A208: No. 1, 207-220 (1973).

The differential cross sections of the ^{2}H(α,αp)n reaction are calculated by a modified off-energy-shell impulse approximation with account taken of the strong corrections that come from the initial-state interaction between the deuteron and α particle; the reactions in the S-, P-, and D-waves are sharply suppressed. A phenomenological method is adopted to determine the reduction parameters of the partial amplitudes concerned with an appropriate approximation. The agreement with the experimental data is excellent both at 29.2 and 42 MeV lab energy. (4 figures) (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 9327, 9510, 9524, 9530, 9532, 9570, 9589, 9624, 9670, 9712, 9713, and 9719.

9534 (JINR-P1-7063) CHARGED PARTICLE EMISSION AT μ^- MESON CAPTURE BY PHOTOEMULSION NUCLEI. Batusov, Yu. A.; Bunyatov, S. A.; Vizireva, L.; Gulkanyan, G. R.; Mirsalikhova, F.; Sidorov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The probabilities of emission and multiplicity distribution of charged particles in μ^--meson capture by light (C,N,O) and heavy (Ag,Br) photoemulsion nuclei are determined. In μ^--meson capture by light nuclei (C,N,O) there were obtained the following values of probabilities (per one capture act) of charged particle emission: for two charged particles W_2 = (4.4 ± 0.7)%, for three charged particles W_3 = (2.1 ± 0.2)%, and W_4 = (0.7 ± 0.1)% for four ones. The upper probability limits of reaction channels with two, three and four charged particle emission are presented for each of C, N, O nuclei. (auth)

9535 (USNDC-3, pp 8-12) THICK TARGET NEUTRON YIELDS FROM PROTON AND DEUTERON BOMBARDMENT OF ^{9}Be FOR NEUTRON RADIATION-THERAPY. Kuchnir, F. T. (Cancer Research Hospital, Chicago); Skaggs, L. S.; Elwyn, A. J.; Mooring, F. P. 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9536 (USNDC-3, pp 84-92) MEASUREMENTS OF THE ^{10}B(n,α) CROSS SECTIONS FOR NEUTRON ENERGIES FROM 1 TO 1000 keV. Friesenhahn, S. J.; Carlson, A. D.; Orphan, V. J.; Fricke, M. P. (Gulf Radiation Technology, San Diego, CA). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9537 (USNDC-3, p 102) NEUTRONS FROM DEUTERON BOMBARDMENT OF Li, C, AND ^{2}H. Weaver, K. A. (Univ. of California, Livermore). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9538 (USNDC-3, p 145) NEUTRON CAPTURE IN FLUORINE FROM 2.5 TO 1500 keV. Macklin, R. L.; Winters, R. R. (Oak Ridge National Lab., TN). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9539 (USNDC-3, pp 161-163) TOTAL NEUTRON CROSS SECTION OF ^{4}He, ^{6}Li, AND ^{7}Li FROM 0.5 TO 30 MeV. Goulding, C. A.; Stoler, P. (Rensselaer Polytechnic Inst., Troy, NY). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9540 (USNDC-3, pp 213-219) FAST NEUTRON POLARIZATION STUDIES. Firk, F. W. K.; Nath, R.; Holt, R. J.; Schultz, H. L. (Yale Univ., New Haven). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9541 EVIDENCE FOR A GIANT QUADRUPOLE RESONANCE IN OXYGEN-16. Wang, W. L. (Department of Physics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213); Shakin, C. M. Phys. Rev. Lett.: 30: No. 7, 301-304 (12 Feb 1973).

We calculate the angular distribution and polarization of the photoneutrons from ^{16}O in the giant-dipole region. We have to supplement our E1 amplitudes, which were obtained previously, with large phenomenological E2 amplitudes; we interpret this as evidence for a giant quadrupole resonance. We show that the importance of E2 amplitudes makes the current data analysis in E1 approximation very doubtful. The assumed E2 resonance is also shown to be easily detected experimentally. (auth)

9542 MIRROR STATES OF NEGATIVE PARITY IN MASS-15 NUCLEI. Mairle, G.; Wagner, G. J. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Phys.; 258: No. 4, 321-327(1973).

Mirror relations between levels of ^{15}N and ^{15}O below 11 MeV are derived from the ^{16}O(d,γ)^{15}N and ^{16}O(d,t)^{15}O reactions. These relations and the resulting negative-parity assignments disagree with previous work. (2 figures, 1 table) (auth)

9543 ^{19}F(α,n), (α,p), AND ^{22}Ne(p,n) AND (p,p$_1$γ) REACTIONS NEAR NEUTRON THRESHOLD. Ehehalt, R.; Shida, Y.; Signorini, C.; Morinaga, H. (Technical Univ., Munich). Nuovo Cim., 15A: No. 2, 209-216(21 May 1973).

The reactions ^{19}F(α,n), (α,p), (α,α$_2$γ) and ^{22}Ne(p,n) and (p,p$_1$γ) were studied with high resolution around the neutron threshold in ^{23}Na. The following resonances were observed: (α,p$_0$): E_α(lab) = (2347.0 ± 0.5) keV, (α,p$_1$): E_α(lab) = (2353.0 ± 0.5) keV, (p,p$_1$γ): E_p(lab) = (3778.0 ± 0.5) keV and E_p(lab) = (3789.0 ± 0.5) keV. The coupling of these resonances with the neutron channel was investigated. It was found that none of the ratios of the alpha-particle channel and proton channel partial width to the p$_1$ channel partial width was in agreement with the values expected from a previous measurement of the ^{22}Na(n,p$_0$), (n,p$_1$) and (n,α) reactions with thermal neutrons. In none of the excitation functions observed any anomaly around the neutron threshold due to the coupling with the neutron channel was observed. An estimate using the S-matrix theory of nuclear reactions shows that this effect should not exceed 2%. (auth)

9544 (n,α) REACTIONS ON ^{11}B, ^{14}N, AND ^{16}O WITH 14-MeV NEUTRONS. Bormann, M.; Kaack, D.; Schroeder, V.; Scobel, W.; Wilde, L. (Univ., Hamburg). Z. Phys.; 258: No. 4, 285-300 (1973).

The angular distributions of the α$_0$ and α$_1$ groups for (n,α) re-

actions on ^{11}B, ^{14}N, and ^{16}O were measured at $E_n = 14.1$ MeV. In the $^{11}B(n,\alpha_0)^8Li$ reaction the compound mechanism seems to be favored, as can be demonstrated with Hauser–Feshbach calculations. In the other reactions direct mechanisms dominate. (10 figures, 1 table) (auth)

9545 STUDY OF ^{17}O AND ^{17}F THROUGH CHARGED PARTICLE REACTIONS. Proctor, I. D. East Lansing, MI; Michigan State Univ. (1972). 159p. University Microfilms Order No. 73-12,803.

Thesis (Ph. D.).

Spectra and angular distributions are presented for the following reactions and beam energies: $^{16}O(d,p)^{17}O$ at 20.93 MeV, $^{16}O(^3He,d)^{17}F$ at 34.64 MeV, $^{16}O(\alpha,^3He)^{17}O$ and $^{16}O(\alpha,t)^{17}F$ at 46.16 MeV, and $^{19}F(p,^3He)^{17}O$ and $^{19}F(p,t)^{17}F$ at 39.82 MeV. The spectroscopic factors S^+ for the $1d_{5/2}$ and $2s_{1/2}$ single-particle states obtained from distorted-wave analyses of the (^{3}He,d), (α,^{3}He) and (α,t) reactions were compared with those obtained from the (d,p) analysis. Values for S^+ extracted from the analysis of the (^{3}He,d) reaction were found to agree with values obtained from the analysis of the (d,p) reaction. Values for S^+ obtained from the analysis of the (α,^{3}He) and (α,t) reactions were found to depend strongly on the optical-model description of the entrance and exit channels. Reliable values for absolute spectroscopic factors from the (α,^{3}He) and (α,t) reactions could not be obtained. The relative values $S^+(\alpha,t)/(\alpha,^3He)$ were also found to be sensitive to details of the distorted-wave-approximation calculation. The enhancement factors ϵ^+, extracted from the microscopic (p,^{3}He) and (p,t) analysis to the ground and first excited states in ^{17}O and ^{17}F, respectively, were compared for different wave functions describing ^{19}F. A shell-model wave function for ^{19}F was necessary to describe adequately the two-nucleon-stripping process. The addition of a spin–orbit force to the description of the two-nucleon-stripping process was not necessary to account for the different (p,t) and (p,^{3}He) stripping processes. (RWR)

9546 ELECTROMAGNETIC LIFETIMES OF NUCLEAR LEVELS BY DOPPLER-SHIFT AND RECOIL METHODS. Gordon, D. M. Pasadena, CA; California Inst. of Tech. (1973). 302p. University Microfilms Order No. 73-7289.

Thesis (Ph. D.).

The Doppler-shift-attenuation (DSAM) and recoil-distance methods were used to measure electromagnetic lifetimes of nuclear levels in ^{16}O, ^{26}Al, ^{30}P, ^{32}P, ^{33}S, ^{35}Cl, ^{37}Ar, ^{38}K and ^{40}K, and the electromagnetic transition strengths deduced from the measured lifetimes were compared with recent nuclear-model calculations. In addition, measurements were performed to investigate the existence and magnitude of possible systematic errors in nuclear lifetimes obtained using the gas-stopper version of the DSA technique due to localized heating of the stopping gas by the incident particle beam. Parameters describing the rate of energy loss of heavy ions in Xe, Ar and He stopping gases were extracted from DSAM measurements of the γ rays from the decay of the 418-keV level of ^{26}Al, whose lifetime is well known from electronic-timing measurements. In addition, the electronic stopping cross sections for ^{12}C and ^{27}Al ions slowing in He and Xe gases were measured for ion energies in the range $560 \le E \le 2320$ keV. Deviations from recent theoretical calculations of electronic stopping power as large as a factor of two were observed. (Diss. Abstr. Int., B)

9547 MEASUREMENTS OF THE NUCLEAR MOMENTS OF ^8Li, ^{12}B, AND ^{13}B. Haskell, R. C. Baltimore; Johns Hopkins Univ. (1972). 82p. University Microfilms Order No. 73-12,140.

Thesis (Ph. D.).

The nuclear magnetic resonance frequencies and the nuclear spin–lattice relaxation times of ^8Li implanted in Au, Pd, and Pt were measured. Estimates of the enhancement factors for the Knight shifts in these metals indicate that the value of the ^8Li magnetic dipole moment is $1.65335 \pm 0.00035\ \mu_N$. The quadrupole couplings of ^{12}B and ^8Li in a single crystal of Be and ^{13}B, ^{12}B, and ^8Li in a single crystal of Mg were observed. In the cases of ^{12}B and ^{13}B the quadrupole resonance lines were distinctly resolved and behaved properly under field reversal and variation of the angle Θ between the crystalline c axis and the external magnetic field. The ratio of the quadrupole couplings of ^{12}B and ^{13}B in Mg indicates that the value of the ratio of the ^{12}B to the ^{13}B nuclear quadrupole moment is 0.358 ± 0.008. The values of $\mu(^8Li)$ and $Q(^{12}B)/Q(^{13}B)$ are compatible with nuclear-shell-model calculations. (Diss. Abstr. Int., B)

9548 NEUTRON DIFFRACTION DISSOCIATION AND COULOMB DISSOCIATION FROM NUCLEI. O'Brien, D. D. Ann Arbor, MI; Univ. of Michigan (1972). 190p. University Microfilms Order No. 73-11,218.

Thesis (Ph. D.).

Diffraction dissociation and Coulomb dissociation of neutrons off carbon, copper, and lead into ($p\pi^-$) pairs were studied. The neutron beam was taken at zero degrees from the beryllium target in the external proton beam. The data were taken at proton beam energies of 21 GeV and 28.5 GeV. Forward-going ($p\pi^-$) pairs were detected in a wire-spark-chamber spectrometer, and the momentum and angles of each particle were determined. The observation of a sharp forward peak in the four-momentum-transfer-squared distribution (or width appropriate to the nuclear radius) indicated that a large fraction of the events were produced coherently. A total of $\sim 1.4 \times 10^5$ coherent events were collected. The mass resolution was $\sim \pm 6$ MeV. There was no evidence of $I = 1/2$ nucleon isobars produced coherently off nuclei in either the invariant ($p\pi^-$) mass distributions or the decay angular distributions. There was evidence of the $\Delta(1236)$ in the lead data, but the $\Delta(1236)$ mass peak was badly distorted by dynamic factors and is shifted to approximately 1.18 GeV. Aside from the $\Delta(1236)$ in the lead data, the invariant ($p\pi^-$) mass distributions showed a single broad enhancement at low mass. Neither the standard Drell–Hiida–Deck model nor the double-Regge-pole model fit the data satisfactorily. The carbon data indicated a spin of the coherently produced ($p\pi^-$) system of $J \ge 3/2$, with pure $J = 3/2$ possible. Pure $J = 1/2$ can be ruled out. No firm conclusions can be drawn from the data concerning s- or t-channel helicity conservation. (Diss. Abstr. Int., B)

9549 DEUTERON–NUCLEUS REACTIONS AT 69.1 MeV AND A DETERMINATION OF NEUTRON DETECTOR EFFICIENCIES. Harrison, G. H. College Park, MD; Univ. of Maryland (1972). 122p. University Microfilms Order No. 73-11,387.

Thesis (Ph. D.).

Angular distributions for the reactions (d,p), (d,t), and elastic and inelastic (d,d) at 69.1 MeV were measured for ^{12}C, ^{40}Ca, ^{90}Zr by using the University of Maryland cyclotron. Optical-model fits to the data were made both with and without the spin–orbit term of the potential, and compared with analyses at other energies. DWBA calculations were performed for inelastic states and the (d,p) ano (d,t) reactions to the strong states by using the best fits from the optical-model analysis. The calculations were performed using the zero-range approximation and using the local energy approximation for finite-range and nonlocality effects. These results were compared with DWBA calculations performed using the adiabatic model of Johnson and Soper for the deuteron potential. The effect on DWBA results of using optical-model fits without the spin–orbit term was also studied. Neutron detection efficiencies with five percent uncertainty were determined in the energy range 25 to 60 MeV for a plastic scintillator detector. Observing the reaction $d + d \rightarrow {}^3He + n$ provided a direct, independent means for efficiency calculation. The neutron pulse height was recorded for each real scattering event; comparison with the ^{3}He counts yielded the neutron detector efficiency as a function of detector threshold. (Diss. Abstr. Int., B)

9550 POLARIZATION AND ANGULAR DISTRIBUTION OF NEUTRONS EMITTED FROM THE $^{18}O(p,n)^{18}F$ REACTION AT PROTON ENERGIES BETWEEN 3.00 AND 3.50 MeV. Lemming, J. F. Athens, OH; Ohio Univ. (1972). 181p. University Microfilms Order No. 73-12,639.

Thesis (Ph. D.).

Angular distribution measurements were made at twenty energies between 3.00 and 3.50 MeV for seven laboratory angles between 0° and 120°. A pulsed-beam time-of-flight spectrometer was utilized along with pulse shape discrimination. The neutron polarization was measured at eight energies between 3.035 and 3.220 MeV for four laboratory angles between 0° and 120°. A multilevel multichannel R-matrix code specialized for up to two levels of same spin and parity was used in an attempt to find a consistent set of spins, parities, and widths. The only contributions to the R matrix were from compound nucleus levels which were explicitly specified. The results of the present experiment do not give unambiguous properties for the compound nucleus levels in the energy region of interest. The results of the present experiment emphasize the necessity of considering all open channels in order to specify fully the properties of the levels observed. (RWR)

9551 DIFFERENTIAL CROSS SECTION AND POLARIZATION OF 2.63-MeV NEUTRONS SCATTERED FROM ^{12}C. Knox, H. D. Athens, OH; Ohio Univ. (1972). 116p. University Microfilms Order No. 73-12,637.

Thesis (Ph. D.).

Neutrons from the $D(d,n)^3He$ reaction were produced in an aluminum drive-in target by a beam of 120-keV deuterons. Neutrons emitted at $\theta_{lab} = 50°$ passed along the axis of a long air-core solenoid, which precessed the spin orientation of the neutrons by 90°. The neutrons were then scattered from a carbon scattering sample and detected by two movable detectors. Associated-particle time-of-flight and pulse shape discrimination were used. The differential cross section and asymmetry were measured at 8 angles between 17° and 118° in the laboratory system. The source

polarization, P_1, of the D(d,n)^{3}He reaction and five phase shifts were included as variables in a program which simultaneously fitted the differential cross section, asymmetry, and total cross section. The results were compared with other experiments and theoretical predictions to obtain phase shifts which best represent data in the energy range up to 5 MeV. (RWR)

9552 POLYNOMIAL APPROXIMATIONS AND TABLES OF SELECTED PROTON CROSS SECTIONS IN ^{12}C AND ^{14}N AS A FUNCTION OF PROTON ENERGY AND SCATTERING ANGLE. Routt, K. R. College Station, TX; Texas A and M Univ. (1972). 820p. University Microfilms Order No. 73-12,288.

Thesis (Ph. D.).

In order to provide smooth and comprehensive cross section data for proton reactions in ^{12}C and ^{14}N, differential cross section data sets expressed as a function of the scattering angle at a fixed value of proton energy were extracted from the published literature and fitted with a series of orthogonal polynomials. The coefficients resulting from these fits were again fitted with orthogonal polynomials over all energies and used to generate the cross section surface as a function of scattering angle and incident proton energy. Tables of the cross section surface and the polynomial parameters are given. (Diss. Abstr. Int., B)

9553 ^{14}N(p,p') AT 29.8, 36.6, AND 40.0 MeV AND THE STRENGTH OF THE TENSOR FORCE IN NUCLEAR REACTIONS. Fox, S. H. East Lansing, MI; Michigan State Univ. (1972). 193p. University Microfilms Order No. 73-12,714.

Thesis (Ph. D.)

Measurements of the angular distribution of the ^{14}N(p,p')-^{14}N* (2.31 MeV), $(1^+;0) \rightarrow (0^+;1)$ reaction were made at higher energies (29.8, 36.6, and 40.0 MeV) and with better precision than before, and information about the strength of the tensor force in nuclear reactions was extracted. Protons from the MSU Sector-Focused Cyclotron were scattered from gas and evaporated melamine ^{14}N targets and detected either with lithium-drifted silicon detectors in a 40″ scattering chamber or with position-sensitive detectors in an Enge split-pole spectrograph. Angular distributions for elastic scattering and the excitation of the $2.31(0^+;1)$- and $3.94(1^+;0)$-MeV states were obtained at all the energies. In addition, the angular distributions for the excitation of the ten known states in ^{14}N between 4.91 and 8.49 MeV were obtained for 29.8-MeV incident protons. Optical-model fits to elastic data between 24.8 and 40.0 MeV were obtained using an average set of optical-model geometry parameters. Microscopic model DWBA calculations with exchange were made for the 2.31-MeV reaction including central, $L \cdot S$, and (most importantly) tensor forces in the two-body interaction. The interaction that best fitted the shape of the inelastic scattering to the 2.31-MeV state at 24.8, 29.8, 36.6 and 40.0 MeV was a Serber central force plus the Hamada–Johnston spin–orbit potential and OPEP with a 25% increase in strength. Results for microscopic model DWBA calculations with exchange are also reported for the reactions to the $3.94(1^+;0)$- and $7.03(2^+;0)$-MeV states. (Diss. Abstr. Int., B)

9554 ANGULAR CORRELATION STUDY OF THE ^{19}F(p,2p)^{18}O REACTION AT 43 MeV. High, M. D. Bloomington, IN; Indiana Univ. (1972). 149p. University Microfilms Order No. 73-6497.

Thesis (Ph. D.).

Symmetric coplanar differential cross sections for the reaction ^{19}F(p,2p)^{18}O(g.s.) at 42.7 MeV were measured at lab angles between 12 and 117°, by measuring the energies of the coincident protons with solid state detectors. The summed energy resolution of 700 keV FWHM allowed clean separation of the ^{18}O ground state from the first excited state at 1.98 MeV. The angular correlation was compared with the results of a distorted wave t-matrix approximation (DWTA) calculation. The distorted waves are calculated from optical model potentials obtained directly from the appropriate elastic scattering experiments. Both harmonic oscillator and finite square well bound state wave functions were used, with the result that the calculation is quite insensitive to the shape of the bound state wave function but very sensitive to the r.m.s. radius. For either bound state wave function, it was found that the positions of the maxima and minima, and the relative magnitudes of the forward rise, first minimum and first maximum of the angular correlation are well described if a pure 2s state wave function is assumed for the bound proton with an r.m.s. radius of 3.90–4.15 fm. It was also found that no amount of a 1d state admixture could improve the agreement with the experimental angular correlation. (Diss. Abstr. Int., B)

9555 ANGULAR CORRELATION FOR THE REACTION ^{10}B(d,α)^{8}Be^{2,g}(α)^{4}He. Sessler, J. C. Washington, DC; Georgetown Univ. (1970). 128p. University Microfilms Order No. 73-11,801.

Thesis (Ph. D.).

The ^{10}B(d,α)^{8}Be^{2,g}(α)^{4}He reaction was studied at a bombarding energy of 0.4 MeV to find the angular correlation of the 2.9-MeV (2^+) state of ^{8}Be. A coincidence technique was used to determine which excited states of ^{8}Be were populated and to find their decay modes. Two surface barrier detectors, in a coplanar geometry, were used in fast–slow coincidence circuitry with a 100 nanosecond resolving time. By use of a multiparameter analyzer, the reaction was found to be sequential through the ground and excited states of ^{8}Be; but the 11.4-, 16.6-, and 16.9-MeV states were populated very little, if at all. A computer program was generated for fitting the observed spectral lines with various correlation function forms. The width of the detectors, width of the state, and angular distribution of the decay in the ^{8}Be center of mass are folded in to obtain the predicted peak shape. (Diss. Abstr. Int., B)

9556 PION PRODUCTION BY 185 MeV PROTONS. Keating, M. P. Bloomington, IN; Indiana Univ. (1972). 136p. University Microfilms Order No. 73-2723.

Thesis (Ph. D.).

Proton–nucleus scattering and the nuclear forward scattering amplitudes are discussed. It is possible to extract the nuclear part of the forward scattering amplitude from small angle proton–nucleus elastic scattering. The process is complicated in practice by the effects of experimental errors and theoretical approximations. Optical model calculations are done, using 14.5 MeV protons on ^{16}O, ^{40}Ca, and ^{90}Zr to examine the effects of these uncertainties on the determination of the nuclear forward amplitude. Pion production by 185 MeV protons incident on ^{12}C is also considered. A distorted wave Born approximation calculation is performed on the differential cross section for the case where ^{13}C is left in either the ground state, or in one of the excited states between 3 and 4 MeV. It is assumed that the pion is emitted only by the incident proton, and the usual Galilean invariant form of the pion–nucleus interaction is taken as the transition operator. Different pion distorted waves are used, and the results are compared to each other and to the available experimental data. (Diss. Abstr. Int., B)

9557 RECOIL EFFECTS IN SINGLE-NUCLEON-TRANSFER HEAVY-ION REACTIONS. DeVries, R. M. (Departement de Physique Nucléaire, Centre d'Etudes Nucléaires de Saclay, 91190 Gif sur Yvette, France); Kubo, K. I. Phys. Rev. Lett. 30: No. 8, 325-328 (19 Feb 1973).

Using a distorted-wave Born-approximation treatment which exactly includes recoil for the data from the reaction ^{12}C(^{14}N,^{13}C)^{13}N at E(^{14}N) =78 MeV, we demonstrate the necessity for including recoil effects in calculations for single-nucleon-transfer reactions with heavy ions. (auth)

9558 MEASUREMENT OF ^{3}He–^{9}Be NEUTRON SPECTRA AND YIELDS BY PULSED BEAM TIME OF FLIGHT TECHNIQUES AND THEIR RADIOBIOLOGICAL APPLICATIONS. Gifford, B. R. Rochester, NY; Univ. of Rochester (1972). 288p. University Microfilms Order No. 72-29, 396.

Thesis (Ph. D.).

Neutron spectra and yields were measured for ^{3}He beams incident on thick targets of beryllium. The time-of-flight technique using a 3-meter flight path was employed to measure neutron energies. The detector was a 2.54-cm-thick NE-213 organic scintillator and pulse shape discrimination was employed to reduce gamma-ray efficiency. The efficiency function of the NE-213 scintillator for neutron energies up to 13 MeV (for five bias levels) and response to protons and electrons were also measured. A semiempirical method for calculating detector efficiencies at arbitrary bias levels was developed. Measurements were made at 10 angles between 0° and 90° inclusive for 16-, 22-, and 26-MeV ^{3}He beams incident on thick Be targets. Measurements were also taken at 0° for 18-, 20-, and 24-MeV ^{3}He beams. All spectra could be fitted to the expression $N(E_n)/E_n = K \cdot \exp(E_n/T)$. In a number of cases, two exponential functions were required to fit the neutron energy distribution. The neutron yield as a function of angle could be expressed by the polynomial $Y[E(^3He)] = \Sigma a_n(\cos\theta)^n$, where θ is the laboratory angle. Polynomial expansion coefficients are given for E(^{3}He) = 16, 18, 20, 22, 24, and 26 MeV. (RWR)

9559 CONTINUUM SHELL MODEL CALCULATIONS FOR ^{15}C. Philpott, R. J. (Florida State Univ., Tallahassee). Nucl. Phys.; A208: No. 2, 236-254(1973).

Microscopic calculations of the discrete and continuous spectrum of ^{15}C are carried out within the framework of the continuum shell model, using a recently developed generalization of the extended R-matrix formalism. Comparison is made with the predictions of a conventional shell model calculation and also with the presently rather meager experimental data. The calculated total elastic and total reaction cross sections for the ^{14}C + n reaction exhibit some interesting resonance phenomena which it would be desirable to investigate experimentally. The calculated stripping

form factors for the $^{14}C(d,p)$ reaction are similar to Woods–Saxon eigenfunctions for those states in ^{15}C which have strong single-particle character, but differ markedly from this shape when the single-particle component is small. The effect on the calculated results of the addition or removal of closed channels is shown to be small. The present calculational method is found to be convenient, flexible and economical. (auth)

9560 INELASTIC ELECTRON SCATTERING AND THE ELECTROMAGNETIC PROPERTIES OF ^{9}Be. Slight, A. G.; Drake, T. E.; Bishop, G. R. (Univ. of Glasgow). Nucl. Phys.; A208: No. 1, 157-195(1973).

The simple Nilsson model was calculated out to higher values of the deformation parameter η, and this was shown to produce the intrinsic state sequence, g.s. $3/2^-$, $1/2^+$ at 1.67 MeV, and $1/2^-$ at about 3 MeV, for not unreasonably large values of η. Rotational bands based on the intrinsic states of the Nilsson model were used to predict the energy spectrum. Electromagnetic transition rates and neutron decay widths were calculated and compared with the measured (γ,n) cross section. The low-q extrapolation of electron scattering data provided evidence for an induced octupole deformation of the ^{9}Be surface. This simple Nilsson model was extended to include coupling between the major shells N, N + 2, N + 4, and N + 6, and the same low-lying intrinsic state sequence was obtained for a lower value of η. The implications of using the wave functions belonging to the larger basis set are briefly discussed. Elastic and inelastic electron scattering from ^{9}Be were measured at q-values of 0.6, 0.8, and 0.9 fm^{-1} and angles 120° and 154°. Form factors for the states at 1.67, 2.43, and 3 MeV were analyzed into longitudinal and transverse contributions, and a similar separation was made for the continuum scattering up to 10 MeV. Wave functions from the extended Nilsson-model calculations were used for comparison with the experimental data. Good fits to the ground-state charge and magnetic form factors were obtained, but the calculated C2 form factor for the $5/2^-$ 2.43-MeV state was low. The transverse form factor in the 3 MeV region was shown to be in good agreement with the model calculation provided M1 coupling to a broad $1/2^-$ state at 3 MeV was included. The data and calculations on the 1.67-MeV $1/2^+$ state were in disagreement. The transverse form factor in the region 4.5 to 6.5 MeV, however, was reasonably well predicted by the Nilsson model. (16 figures, 7 tables) (auth)

9561 NON-NORMAL-PARITY STATES IN A = 7 AND 8 NUCLEI. Aswad, A. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Kissener, H. R.; Jaeger, H. U.; Eramzhian, R. A. Nucl. Phys.; A208: No. 1, 61-76(1973).

Shell-model calculations taking into account all nonspurious 1 $\hbar\omega$ excitations were performed for A = 7 and 8 nuclei. The Hamiltonian was taken from similar investigations of nuclei at the upper end of the 1p shell. Level schemes, E1 radiative widths, and spectroscopic factors for single-nucleon scattering and the knock-out of a 1s proton were calculated. Good agreement with reported data was obtained. The properties of new predicted levels are discussed. Cross sections of (γ,p), (γ,n) and the inverse reactions involving nuclei with A = 6, 7, and 8 are analyzed using R-matrix theory. (6 figures, 7 tables) (auth)

9562 STUDY OF (d,p) REACTIONS TO UNBOUND STATES OF ^{13}C AND ^{17}O. Darden, S. E.; Sen, S.; Hiddleston, H. R.; Aymar, J. A.; Yoh, W. A. (Univ. of Notre Dame, IN). Nucl. Phys.; A208: No. 1, 77-92(1973).

Cross-section and vector-analyzing-power measurements were made for (d,p) reactions on ^{12}C and ^{16}O leading to the unbound fourth, eighth, ninth, tenth, and eleventh excited states in ^{13}C and to the unbound fourth, fifth and eighth excited states in ^{17}O. The results are compared with predictions of the DWBA theory using a form factor for a weakly bound particle and a resonance form factor, (the latter following the approach of Vincent and Fortune). For the transitions in which the stripping mechanism dominates, the two approaches give results of comparable quality, except that the measured cross sections at forward angles are better reproduced using resonance form factors. Resonance widths obtained from the analysis generally agree with those obtained from neutron scattering measurements. Results are also presented for $^{16}O(d,p_3)^{17}O^*$ and for the transitions to the bound states of ^{13}C. (9 figures, 1 table) (auth)

9563 VECTOR AND TENSOR ANALYZING POWER OF (d,p) REACTIONS AND DEUTERON D-STATE EFFECTS. Johnson, R. C. (Univ. of Surrey, Guilford, Eng.); Santos, F. D.; Brown, R. C.; Debenham, A. A.; Greenlees, G. W.; Griffith, J. A. R.; Karban, O.; Kocher, D. C.; Roman, S. Nucl. Phys.; A208: No. 2, 221-235(1973).

The vector and tensor analyzing power was measured for (d,p) reactions on ^{9}Be, ^{12}C, ^{16}O, ^{19}F, ^{25}Mg, ^{28}Si and ^{40}Ca for lab reaction angles from 0 to 50° at 12.3 MeV incident deuteron energy. Fifteen transitions were studied including orbital angular momentum transfers l_n = 0, 1, 2, 3. The experimental results were analyzed in terms of distorted-wave theory including deuteron D-state effects. The calculations show that the deuteron D-state cannot be ignored in the description of the tensor analysing power. The j-dependence of D-state effects is discussed. (auth)

9564 TOTAL PROTON–NUCLEUS CROSS SECTION AND COHERENT PROCESSES IN THE TeV REGION FROM COSMIC-RAY DATA. Bergamasco, L. (CNR, Turin); Castagnoli, C.; D'ettorre Piazzoli, B.; Picchi, P. Lett. Nuovo Cim.; 7: No. 2, 79-83(12 May 1973).

It is stated that there is a strong probability that in the TeV region a great number of inelastic channels of the hadron–nucleus collision may be due to the coherent production of states with a continuous mass spectrum. This possibility is investigated in connection with recent experimental data from extensive air showers. (LBS)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 9532, 9543, 9546, 9563, 9564, 9580, 9589, 9627, and 9670.

9565 (AD–754247) INTERACTIONS OF ENERGETIC NEON WITH EMULSION NUCLEI. McNulty, P. J.; Filz, R. C. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass). 12 Oct 1972. 13p. (AFCRL–PSRP–514; AFCRL-72-607). NTIS.

Measurements of interactions of 280 MeV/N neon nuclei from the Princeton Particle Accelerator with nuclei in emulsions are reported. It is found that the dominant mechanism for nucleus–nucleus interactions for incident neon energies as low as 100 MeV/N is the production of charged and/or neutral pions. (auth) (NTIS)

9566 (USNDC–3, pp 50; 63-65) RESULTS FOR Cl. Singh, U.; Garg, J.; Rahn, F.; Rainwater, J. (Columbia Univ., New York). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9567 (USNDC–3, pp 66; 71-72) R-MATRIX FITTING OF NATURAL SODIUM. Rahn, F.; Slagowitz, M.; Havens, W. W. Jr.; Rainwater, J.; Singh, U. (Columbia Univ., New York). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9568 (USNDC–3, pp 110-111) LIFETIME MEASUREMENTS IN ^{28}Mg. Bardin, T. T.; Becker, J. A.; Chase, L. F.; Fisher, T. R.; McDonald, R. E.; Poletti, A. R.; Pronko, J. G. (Univ. of California, Livermore). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9569 (USNDC–3, pp 211-212) SMALL-ANGLE ELASTIC SCATTERING OF 7.55-MeV NEUTRONS: A SURVEY. Bucher, W. P.; Hollandsworth, C. E.; McNatt, D.; Niiler, A. (Ballistic Research Labs., Aberdeen Proving Ground, MD). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9570 APPLICATION OF POLARIZED DEUTERONS IN (D,pγ) ANGULAR CORRELATION MEASUREMENTS. Gould, C. R.; Nelson, R. O.; Williams, J. R.; Tilley, D. R. (North Carolina State University, Raleigh, North Carolina 27607); Hutton, J. D.; (and others). Phys. Rev. Lett. 30: No. 7, 298-300 (12 Feb 1973).

The application and use of tensor polarized beams of deuterons in (d,pγ) angular correlation experiments with spin–0 targets is described in connection with the measurement of mixing ratios of decays from spin–(3/2) states in ^{13}C and ^{31}Si. (auth)

9571 MEAN LIFETIMES OF LEVELS IN ^{32}P AND ^{32}S. Carr, P. E.; Bailey, D. C.; Green, L. L.; James, A. N.; Sharpey Schafer, J. F.; Viggars, D. A. (Univ. of Liverpool). J. Phys., A (London); 6: No. 5, 705-712(May 1973).

Lifetimes of low-lying levels in ^{32}P and ^{32}S have been measured

using the Doppler shift attenuation method. The levels were populated via the $^{29}Si(\alpha,p)^{32}P$ and $^{29}Si(\alpha,n)^{32}S$ reactions at α particle energies of 8.0 and 9.5 MeV. Seven new lifetimes and two new lifetime limits have been measured in ^{32}P, and one new lifetime has been measured in ^{32}S. The principal decay modes of some levels have been measured. (auth)

9572 INFLUENCE OF NON-CENTRAL INTERACTIONS ON LOW-LYING STATES OF ^{24}Mg. Feldmeier, H.; Manakos, P.; Wolff, T. (Technische Univ., Darmstadt, Ger.). Z. Phys.; 258: No. 1, 81-98(1973).

Shell-model calculations of low-lying positive-parity states of ^{24}Mg were performed in an SU(3) truncated space. In contrast to previous SU(3)-model calculations the experimental spectrum can be reproduced well. This is attained by variation of a certain non-central component of the residual interaction. (6 figures, 4 tables) (auth)

9573 PROTON INDUCED SPALLATION OF ^{20}Ne AND THE ASTROPHYSICAL PRODUCTION OF THE LITHIUM ISOTOPES. Panggabean, L. M. East Lansing, MI; Michigan State Univ. (1972). 168p. University Microfilms Order No. 73-12,795.

Thesis (Ph. D.).

Cross sections for production of masses 6 and 7 in the proton-induced spallation of ^{20}Ne were measured at proton bombarding energies of 30, 35, 40, and 42 MeV. The magnitudes of the mass-6 and mass-7 cross sections at each energy are equal within the experimental uncertainties, both rising from 1.5 mb at 30 MeV to 4 mb at 42 MeV. The angular distributions for both masses at all energies are very similar; they go down monotonically at back angles. The measurements employed the time-of-flight technique for particle identification. The ^{20}Ne target gas was of 99.66% purity. Together with the cross sections for mass 6 and mass 7 that are available in the literature, the cross sections measured in this laboratory were used to calculate the ratio of the production rate of ^{7}Li to that of ^{6}Li by the protons in stellar flares, assuming a spectrum of the form $E^{-\gamma}$, where γ is a constant. It was found that a spectrum $E^{-7.1}$ was required to produce the experimentally observed abundance ratio of 12.5. The steepest spectrum observed in solar flares has $E^{-5.6}$. It is suggested that one must include the $\alpha + \alpha$ reactions as additional sources of ^{7}Li. (RWR)

9574 NUCLEAR STRUCTURE STUDIES IN ARGON AND XENON ISOTOPES. Sen, S. Austin, TX; Univ. of Texas (1972). 162p. University Microfilms Order No. 73-7642.

Thesis (Ph. D.).

Level structures of ^{37}Ar, ^{39}Ar, ^{135}Xe, and ^{136}Xe were investigated via the following reactions: $^{36}Ar(d,p)^{37}Ar$, $^{38}Ar(d,p)^{39}Ar$, $^{136}Xe(p,d)^{135}Xe$, $^{136}Xe(p,p')^{136}Xe$. The data were analyzed in the framework of the distorted-wave Born approximation to obtain nuclear structure information. A microscopic calculation using the quasi-particle random phase approximation was performed for the states of ^{136}Xe, and is compared with experimental results. (Diss. Abstr. Int., B)

9575 EXPERIMENTAL FAST-NEUTRON ALBEDO FROM PLANE SCATTERERS. Segal, Y.; German, U.; Notea, A. (Technion-Israel Inst. of Tech., Haifa). Nucl. Sci. Eng.; 51: No. 2, 223-234(Jun 1973).

The energy spectra of fast neutrons backscattered from aluminium, iron, lead, and Perspex were measured for primary neutron energies of 0.5, 1.0, 1.5, and 1.8 MeV. The energy spectra were obtained as a function of the thickness of the scattering material up to two mean free paths. The experimental results are compared with Monte Carlo-calculated values. (17 figures, 4 tables) (auth)

9576 LIFETIMES IN ^{36}Cl AS MEASURED BY THE DOPPLER-SHIFT-ATTENUATION METHOD. Yousef, A. S. Chicago; Illinois Inst. of Tech. (1972). 132p. University Microfilms Order No. 73-12,236.

Thesis (Ph. D.).

A double-coincidence variant of the Doppler-shift-attenuation method was used to measure the lifetimes of 23 excited states in ^{36}Cl. The states were populated through the $^{35}Cl(d,p)$ reaction at deuteron energy $E_d = 3.5$ MeV, with recoils stopped in $Pb^{35}Cl_2$ and Au. The excitation energies (MeV) and (in parentheses) the measured lifetimes (fs) are as follows: 0.788 (3000 ± 800), 1.163 (3050 ± 600), 1.600 (776 ± 206), 1.951 (1750 ± 550), 1.959 (61 ± 12), 2.469 (473 ± 95), 2.491 (55 ± 15), 2.519 (<5000), 2.680 (<15), 2.813 (1400 ± 550), 2.868 (<10), 2.896 (812 ± 163), 2.995 (69 ± 18), 3.100 (212 ± 48), 3.205 (125 ± 26), 3.332 (110 ± 24), 3.471 (20 ± 19), 3.603 (42 ± 13), 3.635 (32 ± 7), 3.663 (43 ± 11), 3.726 (71 ± 15), 3.966 (36 ± 17), 3.996 (22 ± 6). A total of 61 γ transitions—from states up to 4.0 MeV in excitation—were observed. Branching ratios were determined, and the partial lifetimes deduced from these were compared with the single-particle estimates. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 9524, 9549, 9563, 9564, 9569, 9574, 9575, 9599, 9627, 9646, 9658, 9660, 9670, 9712, 9713, and 9719.

9577 (ORNL-TM-4193) INTEGRAL NEUTRON SCATTERING MEASUREMENTS ON IRON FROM 1 TO 20 MeV. Morgan, G. L.; Love, T. A.; Perey, F. G. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 54p. Dep. NTIS $4.75.

The spectrum of neutrons scattered through 90° by a thick (≈1 mean free path) annulus of iron was measured as a function of the incident neutron energy over the range from 1 to 20 MeV. The measurements were made for an incident neutron beam with smooth energy dependence and with an incident beam structured by an iron filter (also ≈1 m.f.p.). The results of the measurement are presented in forms suitable for comparison with calculations based on the evaluated neutron data files. (11 figures, 8 tables) (auth)

9578 (ORO-3624-13) NORTH CAROLINA STATE UNIVERSITY NUCLEAR STRUCTURE RESEARCH AT THE TRIANGLE UNIVERSITIES NUCLEAR LABORATORY. Progress Report, September 1, 1972–August 31, 1973. Seagondollar, L. W.; Waltner, A. W.; Mitchell, G. E.; Tilley, D. R.; Gould, C. R.; Nelson, R. O. (North Carolina State Univ., Raleigh). 23 May 1973. Contract AT(40-1)-3624. 19p. Dep. NTIS $3.00.

Work is reported in the following areas: studies of electromagnetic transitions in low–medium-mass nuclei, high-resolution studies of fine structure of isobaric analog states, accelerator-induced x-ray studies, nuclear reaction studies, and developments in accelerator operation and experimental facilities. Administrative in nature, this report merely mentions what was done and does not give results. Many of the topics covered have been or will be reported in the open literature. (RWR)

9579 (UCID-16258, p 7) PHOTONEUTRON CROSS SECTIONS OF ^{55}Mn AND ^{59}Co. Alvarez, R. A.; Berman, B. L.; Lewis, F. H.; Meyer, P. 25 Apr 1973.

In Status report to USNDC.

9580 (USNDC-3, pp 16-17) MEASUREMENT OF (n,p) CROSS SECTIONS BY ACTIVATION METHODS. Meadows, J. W.; Smith, D. L. (Argonne National Lab., Ill.). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9581 (USNDC-3, pp 106-108) PHOTONEUTRON CROSS SECTION OF ^{55}Mn AND ^{59}Co. Alvarez, R. A.; Berman, B. L.; Meyer, P. (Univ. of California, Livermore). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9582 (USNDC-3, pp 188-190) DECAY PROPERTIES OF LOW-LYING LEVELS OF ^{53}Fe. Nelson, R. O.; Roberson, N. R.; Gould, C. R.; Tilley, D. R. (Triangle Universities Nuclear Lab., Durham, NC). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9583 (USNDC-3, p 192) $^{54}Fe(p,d)^{53}Fe$ REACTION. Nelson, R. O.; Roberson, N. R.; Gould, C. R.; Tilley, D. R. (Triangle Universities Nuclear Lab., Durham, NC). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9584 PHOTOALPHA REACTIONS IN THE REGION Z = 22 TO Z = 30. Keller, N. A. Toronto; Univ. of Toronto (1971). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The yields and angular distributions of photoalphas from seven elements in the region Z = 22 to Z = 30 were investigated experimentally. Strong anisotropies in the angular distributions from the even-even nuclei were observed. Improved statistical model cal-

culations using the known spins and parities of the low lying levels of the even-even daughters give quite good agreement with the experimental results. (Diss. Abstr. Int., B)

9585 INVESTIGATIONS OF NUCLEAR ELECTROMAGNETIC MATRIX ELEMENTS: QUADRUPOLE PERTURBED ANGULAR CORRELATION AND RECOIL-DISTANCE LIFETIME MEASUREMENTS. McDonald, J. M. Stony Brook, NY; State Univ. of New York (1972). 161p. University Microfilms Order No. 73-10,906.

Thesis (Ph. D.).

The interaction between the electric quadrupole moment, Q, of an excited nuclear level and the electric field gradient(s), EFG, experienced by the excited nuclei was studied, using a time-differential perturbed angular correlation (TDPAC) technique. Positive results were obtained for the ^{111}Cd $5/2^+$ state at 247 keV, recoil implanted into polycrystalline Cd, Zn, and Ti metal backings following Coulomb excitation with 40-MeV ^{16}O ions. The Q–EFG interaction for the ^{111}Cd nuclei implanted in Cd metal was studied as a function of temperature, and the following quadrupole interaction frequencies, ν_Q, (in MHz) were extracted from the data: 117.5 ± 2.7 at 392°K, 129.4 ± 7.0 at 315°K, 128.3 ± 3.3 at 200°K, and 135.0 ± 1.5 at 100°K. It was concluded that the EFG at the ^{111}Cd implantation sites in Cd is static, unique, and axially symmetric, and that a large fraction of the ^{111}Cd nuclei came to rest at lattice sites in the Cd metal. The Q–EFG interaction was also studied for ^{111}Cd implanted into Zn at several temperatures and into Ti at approximately room temperature. The observed ν_Q (in MHz) for ^{111}Cd in Zn and Ti metals at 315°K were 123.6 ± 2.9 and 84.4 ± 6.6, respectively. The amplitude of the TDPAC perturbation pattern was also extracted. Lifetimes for levels in nuclei in the $f_{\frac{7}{2}}$ shell were measured by using the Doppler-shift recoil-distance, or plunger, technique in conjunction with (α,n) or (α,p) reactions. Mean lifetimes or lifetime upper limits (in picoseconds) were obtained: in ^{44}Ca, for the level at 3285 keV; in ^{48}V, for levels at 1100, 1057, 627, 614, 428, 1558, 1267, and 765 keV; in ^{48}Ti, for levels at 3333 and 3509 keV; and in ^{52}Cr, for levels at 3114, 3469, and 3617 keV. Reduced γ-ray transition probabilities were extracted from the experimental lifetime values where possible. (RWR)

9586 SEARCH FOR LOW-LYING LEVELS OF THE GIANT DIPOLE RESONANCE IN ^{40}Ca BY THE ^{39}K(p,γ_0) REACTION. D'Amato, D. P. Columbus, OH; Ohio State Univ. (1972). 106p. University Microfilms Order No. 73-11,480.

Thesis (Ph. D.).

Angular distribution measurements of the gamma rays from proton capture by ^{39}K were made at ten prominent resonances between 3 and 6 MeV proton bombarding energy. These energies correspond to 11.2 to 14.2 MeV excitation energy in ^{40}Ca. The data were taken with a 10 by 15 cm NaI(Tl) anti-coincidence shielded scintillation detector at angles between 0° and 135°. It was found that most of the distributions could be best fitted with P_0 and P_2 Legendre polynomial terms, although four of the distributions (those at E_p = 3.86, 4.45, 4.90, and 5.08 MeV) seemed to require in addition a P_1 term. The distributions at E_p = 4.66 and 4.99 MeV were found to be isotropic with A_2/A_0 for the 4.99-MeV resonance being −0.001 ± 0.014. These isotropic distributions most probably result from s-wave formation of $J^\pi = 1^+$ or 2^+ levels. In all cases, A_2/A_0 was within the limits that might be set on p-wave formation of a $J^\pi = 1^-$ level. f-wave formation apparently represents at best a small contribution. The results are compared with those of other authors, and fair agreement with their results is found. A comparison of the results with a predicted A_2/A_0 coefficient is also made; little agreement with the prediction can be seen. The theoretical coefficient exhibits large swings in amplitude as a function of energy; and, while the experimental A_2/A_0 is found to vary with energy, the large amplitude changes are not present. (Diss. Abstr. Int., B)

9587 STUDY OF ^{50}V USING THE DIRECT REACTIONS ^{49}Ti(^{3}He,d) AND ^{51}V(d,t). Sourkes, A. M. Minneapolis, MN; Univ. of Minnesota (1972). 75p. University Microfilms Order No. 73-10,637.

Thesis (Ph. D.).

Energy levels in ^{50}V up to 4.3 MeV were studied using the ^{49}Ti(^{3}He,d)^{50}V and ^{51}V(d,t)^{50}V reactions with ^{3}He particles of 22 MeV and deuterons of 19.5 MeV incident energy. More than eighty levels were seen, with angular distributions taken for forty-one levels in the (^{3}He,d) reaction and for the ten lowest levels in the (d,t) reaction. The angular distributions were compared with the distorted-wave Born approximation (DWBA) to extract the l values of the transferred nucleons and obtain the spectroscopic strengths. In the stripping reaction, a small amount of l = 0 and l = 2 strength was seen, this strength indicating the presence of s and d proton holes in the ground state of ^{49}Ti. The results are compared with a recent shell-model calculation based on an $(f_{\frac{7}{2}})^n$ configuration, and show qualitative agreement. (Diss. Abstr. Int., B)

9588 EFFECTIVE INTERACTION FOR UNBOUND NUCLEONS AND THE OPTICAL POTENTIAL. Manweiler, R. W. Ithaca, NY; Cornell Univ. (1972). 127p. University Microfilms Order No. 73-7141.

Thesis (Ph. D.).

The effective interaction for an unbound nucleon in a complex nucleus is studied with particular emphasis upon the relation of the unbound state interaction with the interaction for bound states. A successful unified treatment of unbound and bound states is given, and the unbound state effective interaction is related to the standard "optical model." The attractive force for an unbound nucleon is shown to be of an exchange type and is best represented by a nonlocal, energy independent potential which can be calculated, at least for not too high incident nucleon energy, from the attractive interaction between bound nucleons in a nucleus. The unbound state potential is related to the bound state effective force as calculated by Negele using Hartree–Fock theory. A nonlocal potential used by Elton, Webb, and Barrett in a successful analysis of electron scattering is shown, with minor modification, to work remarkably well in an analysis of elastic scattering of protons. Excellent agreement with experiment is obtained for the differential cross section and the polarization of protons with an incident energy up to 60 MeV scattered from ^{40}Ca, ^{58}Ni, ^{120}Sn, and ^{208}Pb. The real potential parameters are shown to be independent of the incident energy and physically reasonable; the imaginary potential parameters agree with expectations from Fermi gas and collective models. Bound state energy levels are also calculated with no readjustment of the real potential parameters in order to check the consistency of the interaction with the bound states, and the results are in good agreement with Negele. The interaction of Skyrme as modified by Vautherin and Brink is also used in an analysis of elastic proton scattering. Good results are obtained for the differential cross section and the polarization for 20-MeV protons scattered from ^{58}Ni. At higher incident proton energy, and for larger nuclei, the results are poorer. (Diss. Abstr. Int., B)

9589 COMPILATION OF keV-NEUTRON-CAPTURE GAMMA-RAY SPECTRA. Bird, J. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights); Allen, B. J.; Bergqvist, I.; Biggerstaff, J. A. Nucl. Data, Sect. A; 11: No. 6, 433-529(May 1973).

A compilation is presented of gamma rays observed following the capture of neutrons in the energy range 5 to 300 keV. Gamma-ray energies and intensities are compared with results from thermal-neutron capture and from (d,p) reactions. Tables include the properties of resonance capturing states (when known) and of final states populated by primary gamma-ray transitions. Decay schemes are given for cases in which specific neutron resonances are resolved. Typical spectra are included to illustrate the experimental results. (65 figures, 41 tables, 113 references) (auth)

9590 PROPERTIES OF GAMMA-RAY TRANSITIONS IN ^{56}Co FROM ^{56}Ni DECAY AND ^{56}Fe(p,nγ)^{56}Co. Samuelson, L. E. East Lansing, MI; Michigan State Univ. (1972). 154p. University Microfilms Order No. 73-12,815.

Thesis (Ph. D.).

^{56}Ni beta decay and the ^{56}Fe(p,nγ)^{56}Co reaction with beam energies between 5.5 and 8.4 MeV were used with Ge(Li) spectrometers to study properties of γ rays from states of ^{56}Co below 2.85 MeV of excitation. The ^{56}Ni decay γ-ray spectrum and $\gamma-\gamma$ coincidences were studied. $\gamma-\gamma$ coincidences, γ-ray excitation functions, γ-ray angular distributions, and absolute cross sections were measured for the ^{56}Fe(p,nγ)^{56}Co reaction. A beta-decay scheme for ^{56}Ni, which includes six γ rays, and an energy-level diagram for ^{56}Co, which includes 35 γ rays (14 of which are reported for the first time) from 20 excited states, are presented. Comparisons of the data from ^{56}Fe(p,nγ)^{56}Co with predictions of the statistical compound nucleus model resulted in spin assignments (in parentheses) for the following states (energies in keV) of ^{56}Co: 158.4 (3), 576.6 (5), 829.7 (4), 970.3 (2), 1009.2 (5), 1114.6 (3), 1450.8 (0), and 1720.3 (1). Branching ratios are presented for 14 γ rays from these eight states, and multipole mixing ratios are given for 12 of these γ rays (10 are predominantly M1). The data are consistent with a spin-4 assignment to the ground state. Contrary to previous suggestions, evidence from all experiments indicates that only one state exists in ^{56}Co in the neighborhood of 1451 keV of excitation. The level energies, γ-ray multipole mixing ratios, and γ-ray branching ratios agree, in general, with shell-model predictions of McGrory. (Diss. Abstr. Int., B)

9591 PAIRING VIBRATIONS IN THE THEORY OF FINITE FERMI SYSTEMS AND APPLICATION TO THE ^{40}Ca REGION. Landi, G.; Matera, F. (Univ., Florence). Nuovo Cim.; 15A: No. 3, 481-493(1 Jun 1973).

The problem of pairing vibrations in normal systems is approached by the theory of finite Fermi systems. In particular, the part of the effective scattering amplitude which is best suited

to treat the pairing vibrations is evaluated. A nonlocal form of residual interaction, which is very close to the usual pairing interaction, is obtained. The comparison with theory and experiment for the nuclei of the ^{40}Ca region turns out to be quite satisfactory. (auth)

9592 LOW-LYING STATES IN ^{48}V. Huber, R. B.; Signorini, C.; Kutschera, W.; Morinaga, H. (Technische Univ., Munich). Nuovo Cim.; 15A: No. 3, 501-520(1 Jun 1973).

The low-lying ^{48}V states were investigated by means of on-beam γ-ray spectroscopy with heavy ions. The reactions ^{40}Ca(^{10}B,2p)^{48}V and ^{40}Ca(^{12}C,3pn)^{48}V were studied at several bombarding energies. Measurements of γ-γ and p-γ coincidences, γ-ray angular distributions and lifetimes with the recoil-distance method allowed several spin-parity assignments for levels up to ~1.5 MeV. Some negative-parity states as well as high-spin positive-parity states were identified. (auth)

9593 LOW-LYING LEVELS IN ^{47}V. Blasi, P. (Univ., Florence); Fazzini, T.; Giannatiempo, A.; Huber, R. B.; Signorini, C. Nuovo Cim.; 15A: No. 3, 521-535(1 Jun 1973).

The low-lying levels of ^{47}V were investigated through the ^{47}Ti(p,n)^{47}V reaction with proton energies between 3.6 and 5.3 MeV and through the ^{40}Ca(^{10}B,2pn)^{47}V reaction at $E_{^{10}B}$ = 25 MeV. From single and γ-γ coincidence spectra the decay scheme has been obtained. Angular distributions in the heavy-ion reaction, conversion coefficient and lifetime measurements were performed to determine the multipolarity of transitions and to assign spin and parity of several levels. (auth)

9594 ^{48}Ti(p,t)^{46}Ti REACTION. Rapaport, J. (Ohio Univ., Athens); Ball, J. B.; Auble, R. L. Nucl. Phys.; A208: No. 2, 371-380(1973).

The ^{48}Ti(p,t) reaction at a proton energy of 51 MeV was used to study the level structure of ^{46}Ti. Angular distributions fitted with distorted-wave Born approximation calculations were used to determine angular momentum transfers. Spin and parity assignments for levels up to 5.0 MeV excitation energy in ^{46}Ti were determined or confirmed and enhancement factors extracted. (auth)

9595 ANOMALOUS ^{3}He SCATTERING IN THE Ca REGION. Morsch, H. P.; Breuer, H. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A208: No. 2, 255-260(1973).

Elastic ^{3}He scattering on ^{40}Ar, ^{39}K, ^{41}K, ^{40}Ca and ^{42}Ca was investigated at E(^{3}He) = 28 MeV. A comparison of the scattering on neighboring nuclei shows differences in backward angle cross sections up to one order of magnitude. This variation is clearly outside the domain of the standard optical model. This anomalous backward angle scattering is discussed in connection with similar anomalies observed in elastic scattering. (auth)

9596 CALCULATION OF THE IMAGINARY PART OF THE NUCLEON–NUCLEUS OPTICAL-MODEL POTENTIAL. Cugnon, J. (Univ., Liege). Nucl. Phys.; A208: No. 2, 333-359(1973).

The imaginary part of the optical-model potential for the scattering of nucleons by nuclei is studied in the frame of the shell-model approach to nuclear reactions. Special attention is paid to the one-hole target nuclei. The imaginary part of the optical-model potential in the second order in the nucleon-nucleus interaction is divided into two parts. The first corresponds to the average resonant scattering. The second corresponds to the inelastic scattering leading to the noncollective states of the target nuclei. A local potential equivalent to the nonlocal theoretical one is constructed in order to facilitate comparison with experiment. Numerical calculations concern the scattering of 14.5 MeV protons by ^{39}K. It is found that the imaginary part depends upon the angular momentum and that its radial variation is governed by strong shell effects. The predicted absorption is approximately 60% of the experimental one. The average resonant scattering contributes to the imaginary part of the optical-model potential as much as the inelastic noncollective excitations of the target. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 9534, 9548, 9556, 9579, 9581, 9584, 9585, 9589, 9623, 9627, 9646, and 9712.

9597 (USNDC–3, pp 27; 31-33) CAPTURE γ-RAYS FROM ^{73}Ge. Holm, J. L.; Garber, D. I.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9598 (USNDC–3, pp 100; 102-106) NUCLEAR CROSS-SECTION CALCULATIONS. Gardner, D. G.; Brownlee, J. L.; Delucchi, A. (Univ. of California, Livermore). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9599 (USNDC–3, pp 155-158) NEUTRON CAPTURE AND TOTAL CROSS SECTIONS. Hockenbury, R. W.; Kaushal, N. N.; Block, R. C. (Rensselaer Polytechnic Inst., Troy, NY). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9600 (USNDC–3, p 188) STUDY OF LOW-LYING LEVELS IN ^{59}Ni. Hutton, J. D.; Roberson, N. R.; Gould, C. R.; Tilley, D. R. (Triangle Universities Nuclear Lab., Durham, NC). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9601 GAMMA DECAY OF ANALOG RESONANCES IN ^{65}Ga, ^{67}Ga, AND ^{69}Ga. Bulthaup, D. C. Columbus, OH; Ohio State Univ. (1972). 113p. University Microfilms Order No. 73-11,464.

Thesis (Ph. D.).

Isobaric analog resonances were investigated in the reactions ^{64}Zn(p,γ)^{65}Ga, ^{66}Zn(p,γ)^{67}Ga, and ^{68}Zn(p,γ)^{69}Ga. Resonance strengths were computed for each resonance observed; and for the ^{68}Zn(p,γ) reaction, where no resonances were observed, an upper limit on resonance strength was determined. In cases where the resonance decayed to more than one level, branching ratios were computed. Only one strong resonance was observed in each of the reactions ^{64}Zn(p,γ), and ^{66}Zn(p,γ). In both cases they involved the decay of a $g_{\frac{9}{2}}$ resonance to a $g_{\frac{9}{2}}$ antianalog state. Basic agreement with the Maripuu rules was found; however, the $g_{\frac{9}{2}}$ resonance in ^{68}Zn(p,γ), expected to be present according to these rules, was not seen, and the angular distribution of gamma rays at the strong resonance in ^{66}Zn(p,γ), expected to be primarily an M1 transition, indicates substantial E2 contribution. (Diss. Abstr. Int., B)

9602 GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN FOUR EVEN–EVEN NUCLEI. Gardulski, P. L. Ann Arbor, MI; Univ. of Michigan (1972). 113p. University Microfilms Order No. 73-6832.

Thesis (Ph. D.).

Gamma–gamma directional correlation measurements were made for cascades in ^{160}Dy, ^{134}Ba, ^{110}Cd, ^{82}Kr, ^{99}Tc, and ^{65}Cu. Spins of nuclear levels as well as the following mixing ratios were determined: ^{160}Dy: $\delta(299) = 0.021 \pm 0.007$, $\delta(879) = 16.3 \pm 1.3$, $\delta(962) = 31^{+40}_{-11}$, $\delta(1178) = -0.047 \pm 0.021$, $\delta(1272) = 0.003^{+0.026}_{-0.003}$. ^{134}Ba: $\delta(475) = 10.3 \pm 3.0$, $\delta(563 = 8.1 \pm 2.4$, $\delta(569) = -0.240^{+0.09}_{-0.11}$, $\delta(796) = -0.002 \pm 0.022$, $\delta(802) = -0.032^{+0.052}_{-0.056}$, $\delta(1039) = -0.59^{+0.11}_{-0.13}$, $\delta(1365) = -0.005 \pm 0.008$. ^{110}Cd: $\delta(678) = 0.26 \pm 0.05$, $\delta(687) = 0.79 \pm 0.13$, $\delta(818) = 1.20 \pm 0.07$, $\delta(885) = 0.0034 \pm 0.0083$, $\delta(937) = -0.003 \pm 0.009$, $\delta(1384) = 0.340^{+0.018}_{-0.018}$, $\delta(1505) = 0.64 \pm 0.10$, $\delta(1562) = -0.034 \pm 0.047$. ^{82}Br: $\delta(619) = -1.93 \pm 0.07$, $\delta(698) = -2.55 \pm 0.32$, $\delta(828) = 0.009^{+0.038}_{-0.009}$, $\delta(1044) < 0.005$, $\delta(1317) = -4.50 \pm 0.18$. ^{65}Cu: $\delta(366) = -9.66 \pm 0.59$. ^{99}Tc: $\delta(740) = 3.61 \pm 0.28$, $\delta(141) = -0.106 \pm 0.012$. In addition the method of Anicin et al. was used to determine the relative EO contribution to the E2 γ transition from the second 2^+ state to the first 2^+ state for the even–even nuclei {^{160}Dy, 879 keV, $[T(EO)/T(E2_\gamma)] \leq 0.010$; ^{134}Ba, 563 keV, $[T(EO)/T(E2_\gamma)] < 0.045$; ^{110}Cd, 818 keV, $[T(EO)/T(E2_\gamma)] \leq 0.594$; ^{82}Br, 698 keV, $[T(EO)/T(E2_\gamma)] = 0.009^{+0.073}_{-0.009}$}. The EO contributions would appear to be accounted for by the appropriate nuclear models for the even–even nuclei. However, no existing model can account for the relative M1 admixtures obtained for some of the transitions in the even–even nuclei. In addition two curved-crystal spectrometers were used to obtain precision energy measurements of gamma rays occurring in the decays of ^{46}Sc, ^{82}Br, ^{99}Mo, and ^{110m}Ag. Many of these energy measurements have sufficient precision to make them suitable for the calibration of Ge(Li) spectra. (Diss. Abstr. Int., B)

9603 SHAPE OF THE β SPECTRUM OF NATURAL ^{87}Rb AT LOW ENERGIES, MEASURED AS THE DIFFERENCE BETWEEN THE ISOTOPES ^{87}Rb AND ^{85}Rb. Ruettenauer, B.; Huster, E. (Univ., Muenster, Ger.). Z. Phys.; 258: No. 4, 351-366(1973). (In German).

The β spectrum of ^{87}Rb was measured in a 4π proportional counter with very thin sources and backings from 0 to 90 keV. In

this region more β particles were found than by other authors. The results confine the nuclear parameters to smaller limits than before. The countings up to 90 keV together with the results of other authors at higher energies lead to an estimated half-life between 4.8 and 5.1×10^{10} years. (5 figures) (auth)

9604 INTERPRETATION OF THE CHANGE IN HALF-LIFE OF ^{89}Zr IN $BaTi(Zr)O_3$ AT THE UPPER PHASE TRANSITION (T_c = 120°C). Leuenberger, H. (Sandoz AG, Basel). Physica; 64: No. 3, 621-624(15 Mar 1973).

An attempt was made to explain the change in the decay constant of ^{89}Zr in $BaTi(Zr)O_3$ at the upper phase transition (T_c = 120°C) by the change of the ligand field. A theoretical estimate of the change in half-life is given. (auth)

9605 MEASUREMENT OF THE $^{75}As(n,2n)^{74}As$ CROSS-SECTION AT 14 MeV. Simpson, C. T.; Crumpton, D.; Francois, P. E. (Univ. of Birmingham, Eng.). J. Inorg. Nucl. Chem.; 35: No. 6, 2085-2087(Jun 1973).

The "mixed powder" method was used to measure the $^{75}As(n,2n)^{74}As$ cross section at 14.1 MeV relative to the $^{65}Cu(n,2n)^{64}Cu$ cross section $t_{\frac{1}{2}}$ of ^{74}As = 18 d, $t_{\frac{1}{2}}$ of ^{64}Cu = 12.8 h). After irradiation the samples were allowed to stand for about 1 hr to allow the 9.8 min activity from the $^{63}Cu(n,2n)^{62}Cu$ reaction to decay. The remaining activities were observed using a Ge(Li) detector. The resolution of this allowed the 511 keV peak due to annihilation gamma-rays to be clearly distinguished from all other gamma-rays from the ^{74}As, ^{64}Cu or interfering activities. The average value of the cross section was determined to be 1030 ± 40 mb at 14.1 MeV. (UK)

9606 ANGULAR DISTRIBUTION OF γ-RAYS FOLLOWING THE (p,n) REACTION ON ^{74}Ge. Mordechai, S. (Negev Univ., Beer Sheva, Israel); Jaffe, A. A.; Nir, D.; Paul, M. Nucl. Phys.; A208: No. 2, 410-416(1973).

The angular distribution of γ-rays excited by the (p,n) reaction on ^{74}Ge, leading to the final nucleus ^{74}As, was measured. The results were compared with the predictions of the compound nucleus statistical model. Possible values of some spins and parities of the low-lying states of ^{74}As at excitation energies of 172, 197, 200, 206, 267 and 273 keV are suggested. The spins and parities of the levels at 173 and 273 keV are determined to be (0^+) and (3^+), respectively. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 8846, 9518, 9534, 9549, 9556, 9564, 9569, 9574, 9585, 9588, 9589, 9598, 9602, 9646, 9658, 9659, 9682, 9686, 9705, and 9727.

9607 (JAERI-M-4968) COMPILATION OF GAMMA-RAY SPECTRA WITH A Ge(Li) DETECTOR (REVISED). Tojo, T.; Kondo, M.; Hieta, M.; Shiraishi, T. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 42p. (In Japanese). NTIS (U. S. Sales Only).

The set of gamma-ray spectra has been compiled for reference use in such experiments as nondestructive assay of nuclear fuel burnup, mutual separation of fission products and neutron flux measurement with activation detectors at the Nuclear Engineering School of JAERI. The spectra compiled are for the 30 nuclides which are often used in the experiments. Measurements of full-energy peak efficiency dependence on photon energy for a Ge(Li) detector using 8 standard sources and also ^{226}Ra in equilibrium with its decay products are given in the Appendix I, gamma-ray scanning for a Ge(Li) detector by a collimated beam in II, and thermal neutron capture gamma-ray spectrum of hydrogen together with the 4.43 MeV gamma-rays from the excited state of ^{12}C due to $^{9}Be(\alpha,n)^{12}C$ reaction in III. This Compilation is the revised edition of JAERI-M 4461 (1971). (auth)

9608 (LFEN-RI-5) FORTRAN PROGRAM LFEN-RE-1. Determination of the Half-Life of a Radioactive Nuclide by Direct Fitting of an Exponential to Experimental Points. Goncalves, I. M. C. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 14p. (In Portuguese). Dep. NTIS (U.S. Sales Only) $3.00.

A FORTRAN program is presented which permits the calculation of the half-life of a radioactive nuclide from values obtained in successive measurements of the activity of a sample containing no other emitters. The experimental data are fitted directly to an exponential by the least-squares method. The basic theory of the program is outlined and then the program is described. The program listing is included. (J.S.R.)

9609 (UCID-16258) STATUS REPORT TO USNDC. Anderson, J. D.; Browne, J. C. (California Univ., Livermore. Lawrence Livermore Lab.). 25 Apr 1973. Contract W-7405-Eng-48. 22p. Dep. NTIS $3.25.

Brief reports on fourteen projects at Lawrence Livermore Laboratory are presented. Subject areas include neutron physics, photonuclear physics, applications, and facilities. Four of these reports, containing noteworthy amounts of data, are separately listed by title. (7 figures, 2 tables) (RWR)

For abstracts of individual sections see: 9579, 9610, 9656, and 9669.

9610 (UCID-16258, pp 3-4) ^{128}Te (n,γ) AND ^{130}Te (n,γ) CROSS SECTIONS FROM 0.5 eV TO 7 keV AND THE XENON ANOMALY IN OLD TELLURIUM ORES. Browne, J. C.; Berman, B. L. 25 Apr 1973.

In status report to USNDC.

9611 (USNDC-3, pp 13-15) FAST NEUTRON TOTAL AND SCATTERING CROSS SECTIONS. Guenther, P.; Moldauer, P.; Smith, A.; Whalen, J. (Argonne National Lab., Ill.). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9612 (USNDC-3, p 37) NEUTRON RESONANCE PARAMETERS OF ^{92}Mo. Wasson, O. A. (Brookhaven National Lab., Upton, NY); Allen, B. J.; Winters, R. R.; Macklin, R. L.; Harvey, J. A. 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9613 (USNDC-3, pp 50-56) PRELIMINARY RESULTS FOR EVEN-A ISOTOPES OF Cd. Liou, H.; Rainwater, J. (Columbia Univ., New York). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9614 (USNDC-3, pp 50; 66-70) EXTENSION OF RESULTS OF ^{139}La. Hacken, G.; Rainwater, J. (Columbia Univ., New York). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9615 NUCLEAR SPECTROSCOPIC INVESTIGATIONS IN THE DECAY OF ^{115m}Cd. Sturm, R.; Theile, F. W.; Thielmann, R.; Gruenberg, E.; Scholz, M. (Univ., Marburg, Ger.). Z. Phys.; 259: No. 1, 93-102(1973). (In German).

The energy levels in ^{115}In at 934, 1133, 1291, and 1419 keV, weakly populated by β decay of ^{115m}Cd, were studied by angular correlation measurements using NaI(Tl) detectors. The previously measured angular correlations of the (485–934)-keV cascade, which is practically isotropic, and (158–1133)-keV cascade were remeasured with higher accuracy. A 286-keV transition between the 1419- and the 1133-keV energy levels was observed, and the highly anisotropic angular correlation of the (286–1133)-keV cascade was also measured. (2 figures, 1 table) (auth)

9616 DECAY OF $^{123g,m}In$ TO THE EXCITED STATES OF ^{123}Sn. Jacobs, E.; de Frenne, D. (Univ., Ghent). Z. Phys.; 258: No. 4, 329-335(1973).

The decay of $^{123g,m}In$ to excited states of ^{123}Sn was investigated. ^{123}In was produced by the $^{124}Sn(\gamma,p)^{123}In$ reaction on an enriched SnO_2 target. The isomeric transition to the ^{123}In ground state was not observed. In the beta decay of ^{123m}In excited states in ^{123}Sn are fed. In the β decay of the ^{123}In ground state only the $^7/_2^+$ level at 1,154 keV in ^{123}Sn is observed. Spins and parities as well as energies are given for these states. (3 figures, 1 table) (auth)

9617 NUCLEAR QUADRUPOLE MOMENT OF ^{105}Pd FROM hfs CONSTANTS. Leelavathi, H.; Ismail, S.; Channappa, K. H. (Bangalore Univ., India). Indian J. Pure Appl. Phys.; 10: No. 11, 820-821(Nov 1972).

The ground state of palladium is $^1S_0$, and it has the electronic configuration of $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}$. The next configuration, $\ldots 4d^95s$, is responsible for giving rise to $^3D_3$, $^3D_2$, $^3D_1$, and $^1D_2$ metastable states. By using the experimentally measured quadrupole interaction constant, B, (Channappa, K. H. & Pendlebury, J. M., Proc. Phys. Soc., 85: 1146(1965)) of the $^3D_3$ state, the

nuclear quadrupole moment, Q, of ^{105}Pd is obtained from the relation $B = (e^2/h)q_J Q$, where q_J is the field gradient at the nucleus and is related to $\langle 1/r^3 \rangle$, which is evaluated by knowing the fine-structure separation between $^3D_3$ and $^3D_1$ metastable levels of palladium. The calculation gives Q = +0.73 b for ^{105}Pd, which compares very well with Q = +0.724 b, obtained by using $\langle 1/r^3 \rangle = 6.1\ a_0^{-3}$, as reported by B. Budick (Phys. Rev., 168: 89(1968)). (1 figure) (auth)

9618 ^{137}Cs AND ^{134}Cs HALF-LIVES DETERMINED BY MASS SPECTROMETRY. Dietz, L. A.; Pachucki, C. F. (Knolls Atomic Power Lab., Schenectady, NY). J. Inorg. Nucl. Chem.; 35: No. 6, 1769-1776(Jun 1973).

An internal standard technique and the precision of ion-counting mass spectrometry were used to follow the decay of ^{137}Cs for a period of 11 yr. The final value for the ^{137}Cs half-life is 30.174 yr ± an uncertainty (precision) of 0.034 yr at the 99% confidence level. In a separate experiment, spanning 9.8 yr and undertaken to test certain aspects of the internal standard technique, the ^{134}Cs half-life was measured to be 2.062 yr ± an uncertainty (precision) of 0.005 yr at the 99% confidence level. (auth)

9619 DECAY OF ^{94}Sr. Grimm, W.; Herzog, W. (Univ., Mainz). Z. Phys.; 259: No. 1, 67-73(1973). (In German).

The nuclide ^{94}Sr was isolated by chemical separation methods after thermal-neutron-induced fission of ^{235}U. Its decay properties were investigated by means of semiconductor spectrometers and coincidence techniques. A half-life of 74.1 ± 0.3 sec was found. Besides the 1428.3-keV γ ray, 4 new γ rays were found which could be placed in a decay scheme containing three excited states of ^{94}Y. The 1^+ states in the odd–odd nuclides ^{90,92,94}Y and ^{88,90,92}Rb are compared. (5 figures, 1 table) (auth)

9620 HALF-LIFE AND GAMMA-RAY ENERGIES OF ^{144}La. Ohyoshi, A. (Kumamoto Univ., Japan); Ohyoshi, E.; Tamai, T.; Takemi, H.; Shinagawa, M. J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 658-661(Nov 1972).

A procedure using a complexing agent (NTA) in paper electromigration was devised to achieve rapid separation of fission product lanthanum. This technique permits direct observation of the decay of the 42 sec ^{144}La without interference from the radiation of other fission products. The γ-ray spectrum of ^{144}La was measured with a high-resolution Ge(Li) detector, and the following γ-transitions were observed: 397, 434, 541, 586, 704, 734, 845, 951 and 1,292 keV. Their relative intensities were also determined. From the decay plots of the two strong photopeaks at 397 and 541 keV, the half-life of the ^{144}La was determined as 42.4 ± 0.6 sec which is more accurate than that of 41 ± 3 sec previously reported. It is concluded that the separation procedure used in the present study can be adapted to the isolation of other short-lived fission products as well whenever their metal ions from the complexes by different values of the equilibrium constant. (auth)

9621 EXCITED LEVELS OF ^{133}Ba FROM THE DECAY OF ^{133}La. Reuland, D. J.; Pagliughi, D. W. (Indiana State Univ., Terre Haute). J. Inorg. Nucl. Chem.; 35: No. 6, 1777-1785(Jun 1973).

Energy levels of ^{133}Ba populated in the decay of ^{133}La were studied. An energy level diagram incorporating six new levels and many new transitions is proposed on the bases of high resolution γ-spectra, γ–γ coincidence experiments and previously reported data. Spin and parity assignments are made from log ft values for β-decay to these levels and multipole order determinations of transitions de-exciting them. A comparison with the energy levels of ^{135}Ba is reported. (auth)

9622 HALF-LIFE OF ^{129m}Xe. Miller, L. D.; Schima, F. J. (National Bureau of Standards, Washington, DC). Int. J. Appl. Radiat. Isotop.; 24: No. 6, 353(Jun 1973).

A determination of the isomeric half-life from intensity measurement of the 196 keV γ ray of ^{129}Xe made at various times over a period of time equivalent to approx. 4.5 half-lives is reported. The weighted mean value of the half-life and estimated standard error were found to be 8.89 ± 0.02 d. This value is about 11% larger than the 8.0 ± 0.2 d value reported by Bergstroem (Ark. f Fys.; 5: 191 (1952)) and Nature, London; 167: 634 (1951)). (UK)

9623 GAMMA-RAY SPECTRA FROM THE INTERACTION OF 14-MeV NEUTRONS WITH COPPER, ZIRCONIUM, AND ANTIMONY. Stamatelatos, M.; Lawergren, B.; Lidofsky, L. J. (Columbia Univ., New York). Nucl. Sci. Eng.; 51: No. 2, 113-118 (Jun 1973).

High energy gamma-ray spectra from the radiative capture of 14-MeV neutrons by copper, zirconium, and antimony were measured with a coincidence–anticoincidence telescope pair spectrometer. These spectra are compared with predictions from calculations using the semidirect (collective) capture model. The parameter values used were derived from other types of experiments and from nuclear models. Agreement is found both in shape and in magnitude without further adjustment of parameters. Partial radiative capture cross sections, obtained by integrating the gamma-ray spectra for gamma energies in excess of 14 MeV, are compared with values from other measurements. (4 figures, 3 tables) (auth)

9624 MEASUREMENT OF THE NEUTRON TOTAL CROSS SECTIONS OF ZIRCALOY-2, ZIRCONIUM-90, AND CARBON BETWEEN 0.4 AND 2.4 MeV. Stooksberry, R. W.; Anderson, J. H. (Bettis Atomic Power Lab., West Mifflin, PA). Nucl. Sci. Eng.; 51: No. 2, 235-239(Jun 1973).

The total neutron cross sections of Zircaloy-2, ^{90}Zr, and carbon were measured in the energy range 0.4 to 2.4 MeV by using the Bettis 3-MeV Van de Graaff pulsed-beam time-of-flight system in conjunction with a NE213 pulse-shape discrimination transmission detector for gamma-ray discrimination. Results obtained for Zircaloy-2 are significantly lower than prior evaluated data near 1 MeV. In addition, the ^{90}Zr results average 6 to 7% below the Zircaloy-2 results. (6 figures, 2 tables) (auth)

9625 NUCLEAR DATA SHEETS FOR A = 128. Auble, R. L. (Oak Ridge National Lab., TN). Nucl. Data, Sect. B; 9: No. 2, 157-193(Feb 1973).

Nuclear structure data available through December 1972 are compiled, and adopted level properties and decay schemes are presented. The first section of the compilation consists of drawings summarizing essentially all available reaction and radioactivity data. The second section, "Summary Sheets," contains adopted level properties and, where space permits, tabulated data upon which they are based. The third section, "Data Sheets," is used only for those nuclei requiring extensive data tabulations. (auth)

9626 STUDY OF ISOBARIC ANALOG RESONANCES SEEN IN PROTON INELASTIC SCATTERING FROM ^{120}Sn. Ragland, T. V. Austin, TX; Univ. of Texas (1972). 109p. University Microfilms Order No. 73-7624.

Thesis (Ph. D.).

Proton elastic and inelastic scattering excitation functions were taken on ^{120}Sn from 7.40 to 11.54 MeV at angles of 119°, 139°, and 159°. Angular distributions were taken at 7.55, 8.00, 10.00, and 10.18 MeV. The usual shell-model approach was used to analyze the elastic scattering data and obtain spectroscopic factors. A parameterized form of a more nearly complete shell-model theory was used to analyze the data from inelastic scattering to the collective 2^+ and 3^- states at excitation energies of 1.16 and 2.38 MeV, respectively. The predictions of this theory on the asymmetry of the peaks in the inelastic excitation functions are discussed. (Diss. Abstr. Int., B)

9627 NUCLEAR DATA SHEETS: RECENT REFERENCES. Nucl. Data, Sect. B; 9: No. 1, 1-124(Jan 1973).

Recent References, issued three times a year as part of the Nuclear Data Sheets, is a current guide to experimental nuclear physics papers. The information is described by a key word string, from which a user should be able to tell whether the indexed paper contains results relevant to his interests. The present volume covers literature received by the Nuclear Data Project or assigned key numbers between the dates September 1, and December 31, 1972. (RWR)

9628 DIRECTIONAL CORRELATIONS OF GAMMA RADIATIONS EMITTED FROM NUCLEAR STATES ORIENTED BY NUCLEAR REACTIONS OR CRYOGENIC METHODS. Krane, K. S. (Los Alamos Scientific Lab., NM); Steffen, R. M.; Wheeler, R. M. Nucl. Data, Sect. A; 11: No. 5, 351-406(Apr 1973).

Directional correlations of gamma radiations emitted from nuclear states that are oriented by nuclear reactions, cryogenic methods, or observation of a preceding radiation are discussed. A simple formulation of the directional-correlation-from-oriented-states function in terms of generalized F coefficients is presented. Numerical tables of all the pertinent geometrical coefficients were computed. Various experimentally convenient geometries of the detectors are discussed, with particular emphasis on their sensitivity to the multipole mixing ratios of the gamma radiation. (22 figures, 2 tables) (auth)

9629 BETA-DELAYED PROTON EMITTER ^{113}Xe. Hagberg, E.; Hansen, P. G.; Jonson, B.; Joergensen, B. G. G.; Kugler, E.; Mowinckel, T. (CERN, Geneva). Nucl. Phys.; A208: No. 2, 309-316(1973).

The ISOLDE facility at the CERN synchrocyclotron was used for extending the series of β-delayed proton emitters in xenon to masses lighter than those previously observed (^{115,117}Xe). Owing to the rapid decrease of the yields, experiments with solid-state counters were inconclusive, and instead a new and much more sensitive method based on nuclear emulsions was developed. The

mass range 111 to 114 showed one new activity, ^{113}Xe, with a half-life of 2.8 ± 0.2 sec. From measurements of the track lengths for a total of 1130 protons from ^{113}Xe it was possible to determine the energy spectrum. The results extend the systematics of β-strength functions in the light xenon isotopes. (auth)

9630 SEARCH FOR SHAPE ISOMERS IN NEUTRON-DEFICIENT EVEN Xe AND Ba ISOTOPES IN THE NANOSECOND TIME RANGE. Inamura, T. (Inst. of Physical and Chemical Research, Saitama, Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 66: No. 3, 141-149(Sep 1972).

A search for isomeric states in ^{116,118,120}Xe and ^{124,126}Ba produced by bombardment of ^{107,109}Ag and ^{115}In with ^{14}N ions was performed in the nanosecond time range. No isomers having half-lives of more than 10 ns were found. A possibility of shape isomerism in ^{120}Xe and ^{126}Ba is discussed in detail by taking into consideration energies of the ground states and the two-quasi-particle excited states, shape-hindered transition probabilities, and isomeric cross section ratios. (auth)

9631 REACTIONS OF ^{40}Ar WITH ^{159}Tb, ^{142}Nd, AND ^{144}Sm; NEW α-ACTIVITIES FROM ^{189}Bi, ^{173}Pt, AND ^{177}Au. Gauvin, H.; Hahn, R. L.; Le Beyec, Y.; Lefort, M.; Livet, J. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys.; A208: No. 2, 360-370(1973).

Reactions of ^{40}Ar ions with targets of ^{159}Tb, ^{142}Nd, and ^{144}Sm were studied at energies below 300 MeV with a helium gas-jet system. Excitation functions for (Ar,xn) reactions, where x = 5 to 10, were obtained for the radioactive products that decay by α-emission. Based on the characteristics of these excitation functions and on the systematics of α-decay, evidence is presented for the existence of the nuclides ^{189}Bi with α-particle energy E_α = 6.67 ± 0.01 MeV and half-life <1.5 sec, and ^{173}Pt with E_α = 6.19 ± 0.01 MeV; and for the emission from ^{177}Au of an α-particle with E_α = 6.15 ± 0.01 MeV. (auth)

9632 INELASTIC SCATTERING OF PROTONS FROM ^{100}Mo AND ^{98}Mo. Awaya, Y.; Matsuda, K.; Wada, T.; Nakanishi, N.; Takeda, S. (Inst. of Physical and Chemical Research, Wako, Japan). J. Phys. Soc. Jap.; 33: No. 4, 881-889(Oct 1972).

Angular distributions of elastically and inelastically scattered protons from ^{100}Mo and ^{98}Mo were measured at E_p = 14.7 MeV. Results were analyzed in terms of the optical model and the distorted-wave Born approximation theory. In addition, the differential cross sections for the first 2^+ and 3^- states and those for the possible members of two-quadrupole-phonon triplet were compared with coupled-channel calculations. Reasonable agreements between the experiment and the theory were obtained except for the second 0^+ state of ^{100}Mo. Admixture of one-phonon component was required for the second 2^+ state. (auth)

9633 SLOW NEUTRON RESONANCES OF ANTIMONY. Ohkubo, M.; Nakajima, Y.; Asami, A.; Fuketa, T. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 33: No. 5, 1185-1196(Nov 1972).

The total neutron cross section of natural antimony has been measured by the transmission method by using the time-of-flight spectrometer of the JAERI linear accelerator with maximum time resolution of 10 nsec/m. The resonance energies of about 100 levels below 1400 eV have been determined. The neutron widths of 47 levels below about 400 eV and the total widths of 11 levels out of those 47 levels have been obtained by the area analysis and the thick-thin method. The isotope assignments of resonances by others are utilized in the analyses. The average level spacings and the strength functions for the energy region below 350 eV are obtained to be $\langle D \rangle$ = 7.5 ± 0.5 eV and $S = (0.26 \pm 0.06) \times 10^{-4}$ for natural Sb, $\langle D \rangle$ = 11 ± 1 eV and $S_0 = (0.23 \pm 0.07) \times 10^{-4}$ for ^{121}Sb, and $\langle D \rangle$ = 25 ± 3 eV and $S_0 = (0.28 \pm 0.1) \times 10^{-4}$ for ^{123}Sb.

9634 COMPARISON OF THE ^{94}Mo(p,n)^{94}Tc^{m,g} and ^{96}Mo(p,n)^{96}Tc^{m,g} REACTIONS. Hogan, J. J. (McGill Univ., Montreal). J. Inorg. Nucl. Chem.; 35: No. 6, 2123-2125(Jun 1973).

Anomalous isomer ratios have been reported (Hogan, J. Inorg. Nucl. Chem.; 35: 705(1973)) for the ^{96}Mo(p,n)^{96}Tc^{m,g} reaction over the bombarding energy region 10 to 65 MeV. The ratio of the production cross section for the metastable 4+ state to that of the 7+ ground state decreased by nearly three orders of magnitude over this region. It was thought possible that the anomalous effect might be reproduced in the ^{94}Mo(p,n)^{94}Tc^{m,g} reaction. The ground state spins of both target and product are the same as those of the ^{96}Mo system: the metastable states are similar, and the nuclear structure differs only by the absence of two, presumably paired, neutrons. The isomer ratios for the ^{94}Mo(p,n)^{94}Tc^{m,g} reaction were measured and compared to those for the ^{96}Mo(p,n) reaction. The results show that the isomer ratios behave in grossly different fashion. In the energy region above 25 MeV, the ^{94}Mo results show a nearly constant m/g ratio of about 1.2. The ^{94}Mo(p,n) reaction is easily understandable, while the previous results on ^{96}Mo remain unexplained. (UK)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 8217, 9589, 9602, 9627, 9631, 9670, 9682, and 9731.

9635 (JINR-P6-7007) PROBABILITIES OF γ-TRANSITIONS IN ^{163,165}Er. Ion-Mihai, R.; Marupov, N. Z.; Morozov, V. A.; Muminov, T. M.; Fuia, H.; Khalikulov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The probabilities of γ transitions which de-excite the states at 47.2, 77.2, 242.8, 296.0, 297.2, 356.5, 507.4, and 746.0 keV in ^{165}Er and 69.2, 84.0, and 104.3 keV in ^{163}Er are studied. The results obtained are discussed in the framework of the Nilsson model with pairing correlations and Coriolis interactions taken into account. (2 figures, 5 tables) (auth)

9636 (LA-5221) EVALUATION OF THE RADIATIVE-CAPTURE CROSS SECTION FOR TUNGSTEN. Devaney, J. J. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 22p. Dep. NTIS $4.00.

An evaluation of the smooth neutron radiative-capture cross section for tungsten and its isotopes between 0.006 and 20 MeV is presented. Included are multiple-reaction corrections to the data, which lower the cross section appreciably, especially above 1 MeV. The results are available in ENDF/B format. (16 figures) (auth)

9637 (RLO-2225-T-27-2) HIGH ENERGY PHYSICS STUDIES OF PARTICLE INTERACTIONS IN HEAVY ELEMENTS. Final Report for the Period May 15, 1972-May 14, 1973. Lord, J. J. (Washington Univ., Seattle. Dept. of Physics). 29 May 1973. Contract AT(45-1)-2225. 10p. Dep. NTIS $3.00.

Nuclear track photographic emulsions were exposed to the 200 GeV proton beam at the National Accelerator Laboratory, in order to search for new short-lived particles or processes. The spacial resolution of the emulsion made it possible to search for lifetimes (10^{-17} to 10^{-12} second) which are beyond the range of conventional instruments such as counters and bubble chambers. Some of the emulsions were loaded with tungsten metal powder so that reactions of protons with large nuclei could be studied. The tungsten metal targets were of the order of 10 microns in diameter and made it possible to see the tracks of nearly all charged particles emitted from a p-tungsten collision. An analysis was made of the nature of the intranuclear cascade in heavy nuclear matter. The experimental techniques developed in this experiment made it possible for the first time to determine multiplicities and angular distributions of emitted particles for proton collisions in large nuclei at GeV energies. (auth)

9638 (USNDC-3, p 25) COHERENT SCATTERING LENGTH OF ^{169}Tm. Lander, G. H.; Brun, T. O. (Argonne National Lab., Ill.). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9639 (USNDC-3, pp 26-30) SEARCH FOR DIRECT CAPTURE IN ^{162}Dy(n,γ)^{163}Dy. Cole, G. W.; Mughabghab, S. F.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9640 (USNDC-3, pp 50; 57-62) RESONANCE PARAMETERS OF ^{181}Ta. Garg, J.; Hacken, G.; Liou, H.; Rainwater, J.; Rahn, F. Columbia Univ., New York). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9641 (USNDC-3, pp 72-76) NEUTRON RESONANCE PARAMETERS OF ^{183}W. Camarda, H.; Liou, H.; Makofske, W. (Columbia Univ., New York). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9642 (USNDC-3, pp 77-82) CAPTURE RESONANCE PARAMETERS OF ^{169}Tm. Arbo, J.; Felvinci, J.; Melkonian, E.; Rahn, F.; Ho, C.; Havens, W. W. Jr. (Columbia Univ., New York). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9643 SPECTRA OF γ RAYS AND CONVERSION ELECTRONS OF ^{184}Re AND ^{184}Re*. Ageev, V. A.; Kravtsov, V. V.; Maidanyuk, V. K.; Mitrokhovich, N. F.; Ngo Fu An; Strizhak, V. I.; Feoktistov, A. I.; Fominykh, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 63-67(Jan 1973). (In Russian).

Measurements were made of the γ spectrum and the $\gamma-\gamma$ coincidence spectra of the ^{184}Re isomers using Ge(Li) detectors. Selected sections of the conversion-electron spectrum were investigated with a magnetic spectrometer. (2 figures, 3 tables) (tr-auth)

9644 BETA DECAY OF ^{176m}Lu. van der Werf, S. Y. (Univ., Groningen, Netherlands). Z. Phys.; 259: No. 1, 45-50 (1973).

The shape factors of the $1^- \rightarrow 2^+$ and $1^- \rightarrow 0^+$ beta transitions and the $\beta-\gamma$ directional correlation of ^{176m}Lu were measured. An analysis in terms of nuclear matrix elements is given. (4 figures, 2 tables) (auth)

9645 LIFETIME OF THE SECOND EXCITED STATE IN ^{157}Gd. Dar, Y. (Technion-Israel Inst. of Tech., Haifa); Gerber, J.; Macher, A.; Vivien, J. P. Z. Phys.; 256: No. 3, 253-257(1972).

The mean life time of the 131.5-keV, $^7/_2^-$ state in ^{157}Gd was measured using a modified version of the microwave method. The result obtained is $\tau = 137 \pm 7$ ps. The deduced magnetic parameters g(K), g(R) are discussed and compared with theory. (2 figures) (auth)

9646 LOW-ENERGY GAMMA RAYS FROM THERMAL NEUTRON CAPTURE. Henkelmann, R. (Technische Univ., Munich). Z. Phys.; 258: No. 4, 315-320(1973).

The P2 beam tube of the 4-MW FRM pool reactor was used as the neutron source for this nuclear spectroscopy study. Two lithium-drifted germanium detectors, 8.5 and 13.5 cm, were used as gamma-ray detectors to measure the low-energy prompt photon emissions from thermal-neutron capture in 18 elements (12 rare earth elements) having a σ/A value greater than 0.1. The energy region was from 50 to 500 keV. The energy and intensity of the gamma-ray lines are given. (1 figure, 1 table) (auth)

9647 INVESTIGATION OF IMPACT AS A TOOL FOR STUDYING THE MAGNETIC DIPOLE MOMENTS OF EVEN OSMIUM AND TUNGSTEN NUCLEI. Sioshansi, P. Lafayette, IN; Purdue Univ. (1972). 140p. University Microfilms Order No. 73-6107.

Thesis (Ph. D.).

The ion IMplantation Perturbed Angular Correlation Technique (IMPACT) was used to study the interaction between the magnetic dipole moment, μ, of the first 2^+ excited state of even osmium and tungsten nuclei with the effective magnetic field, H_{eff}, at the nuclear site in a ferromagnetic host. A beam of 36 MeV ^{16}O projectiles was used to Coulomb excite and recoil the osmium and tungsten nuclei into a polarized ferromagnetic backing. In this environment, the nucleus experiences a strong magnetic field and precesses with a Larmor frequency about the field before emitting the deexcitation gamma-ray. The precession in the angular distribution of the deexcitation gamma-rays, measured in these experiments, is proportional to the magnetic interaction. The observed angular precessions were $\omega\tau(^{192}\text{Os}) = 0.216 \pm 0.009$, $\omega\tau(^{190}\text{Os}) = 0.277 \pm 0.008$, $\omega\tau(^{188}\text{Os}) = 0.391 \pm 0.024$ and $\omega\tau(^{186}\text{Os}) = 0.381 \pm 0.075$, $\omega\tau(^{184}\text{W}) = 0.163 \pm 0.011$, $\omega\tau(^{186}\text{W}) = 0.167 \pm 0.007$. The result for angular precession measurements in ^{192}Os was found to be in excellent agreement with a perturbed angular correlation (PAC) technique in nickel using radioactive sources. It was found that the internal field experienced by osmium nuclei implanted in nickel is in good agreement with the value obtained by a room temperature NMR technique. This information verifies the validity of IMPACT as an experimental tool to measure g-factors of osmium nuclei. The available direct lifetime measurements of ^{186,188}Os, ^{184,186}W and lifetimes extracted from B(E2) values for ^{190,192}Os are used to obtain the gyromagnetic ratios: $g_{2^+}(^{186}\text{Os}) = 0.24 \pm 0.05$, $g_{2^+}(^{188}\text{Os}) = 0.29 \pm 0.03$, $g_{2^+}(^{190}\text{Os}) = 0.39 \pm 0.03$, $g_{2^+}(^{192}\text{Os}) = 0.39 \pm 0.03$, $g_{2^+}(^{186}\text{W})/g_{2^+}(^{184}\text{W}) = 1.27 \pm 0.10$. The internal field of tungsten in nickel is not well known; however, the g-factor of the first excited state of ^{184}W is known to be $g_{2^+}(^{184}\text{W}) = 0.282 \pm 0.009$. By using this value in conjunction with the angular precession results, one obtains H_{hf}^{W} (in nickel) = 72 ± 5 KG and $g_{2^+}(^{186}\text{W}) = 0.356 \pm 0.025$. The use of iron as the host for IMPACT measurements of osmium gives rise to angular precessions which are smaller than expected, on the basis of the measured magnetic field of osmium in iron. The iron results are difficult to interpret. (Diss. Abstr. Int., B)

9648 STUDY OF THE (p,t) REACTIONS ON NUCLEI IN THE RARE EARTH REGION. Oothoudt, M. A. Minneapolis, MN; Univ. of Minnesota (1972). 148p. University Microfilms Order No. 73-10,615.

Thesis (Ph. D.).

The (p,t) reaction was used to study nuclei in the rare earth region at a beam energy of 19 MeV with an overall resolution of about 12 keV. Only L = 0 transitions may be unambiguously identified on the basis of angular distributions. Isotopic targets of ^{180}Hf, ^{178}Hf and all the stable Yb isotopes were studied. For the even-N nuclei, members of the ground-state rotational bands up to 6^+ were observed in most cases. Excited 0^+ states were populated by (p,t) in ^{174}Yb and ^{176}Hf with up to 26% of the ground-state strength. In other even-N Hf and Yb nuclei, excited 0^+ states receive at most 5% of the ground strength. The ^{174}Yb and ^{176}Hf strong 0^+ states are discussed in terms of possible nuclear collective modes and in terms of a simple two-level model with unequal (p,t) amplitudes for different Nilsson single-particle levels. A comparison of DWBA and coupled-channels calculations from recent publications shows that the latter calculations fit higher members of K = 0 bands much better. Members of gamma-vibrational bands were observed with appreciable strength; the bandhead typically receives 5 to 10% of the ground-state strength. Several 3^- members of octupole bands were observed with 2 to 5% of the ground strength. In addition, several previously known two-quasi-particle states were observed. Unnatural-parity states, such as 3^+ members of gamma-vibrational bands, were weakly populated. For the odd-N nuclei ^{171}Yb and ^{169}Yb, the lowest L = 0 transition was found to proceed to a single-quasi-particle state with the same quantum numbers as the target ground state with about half the strength of the lowest L = 0 transitions in the neighboring even-N nuclei. A large number of other one-quasi-particle states were populated weakly in the odd-N nuclei, as well as a possible K = 0 vibration in ^{171}Yb based on the ^{173}Yb ground state with 13% of the lowest L = 0 strength. The (p,t) reactions on natural targets of Ta, Au, and even-Z elements in the rare earth region from Gd through Os give information on two-neutron separation energies and trends in cross sections for members of ground, gamma, octupole and strongly excited L = 0 transitions. The ^{176}Yb(p,p') reaction to the first three members of the ground-state band was also used to obtain optical-model parameters and absolute cross sections. (Diss. Abstr. Int., B)

9649 STUDIES OF THE LEVEL STRUCTURES OF ^{181}W, ^{185}Os, AND ^{187}Os BY RADIOACTIVE DECAY SPECTROSCOPY. Ahlgren, K. J. B. Lafayette, IN; Purdue Univ. (1971). 160p. University Microfilms Order No. 73-6149.

Thesis (Ph. D.).

The level structures of the nuclei ^{181}W, ^{185}Os, and ^{187}Os were investigated by studying the radioactive decay of the neutron deficient nuclei 20 h ^{181}Re, 14 h ^{185}Ir, and 11h ^{187}Ir. The radioactive sources were produced by ^{3}He and ^{4}He ion bombardments of tantalum and isotopically enriched rhenium targets. Detailed γ-ray singles and $\gamma-\gamma$ coincidence measurements were performed using Ge(Li) spectrometers and the results were combined with those of earlier high resolution conversion studies to extract multipolarities and total transition intensities. The ^{181}Re decay study has established a ^{181}W level scheme which accommodates about 99% of the decay intensity and which differs in many respects from earlier proposals. An interpretation of the ^{181}W level structure in terms of the Nilsson model is presented, which is consistent with the results of recent independent neutron transfer reaction studies as well as the decay data. The ^{185}Ir decay study has confirmed the validity of the low energy ^{185}Os level spectrum proposed by other workers; however, this study has led to the discovery of several new ^{185}Os levels in the 1700 to 2100 keV energy range, which are populated quite strongly in ^{185}Ir decay. The ^{187}Ir decay study has established an ^{187}Os level scheme which accommodates all the strong transitions observed; the results strongly support one of the two earlier alternative interpretations of the low-lying level structure of ^{187}Os and several other intrinsic excitations in this nucleus were identified for the first time. It was found that the Nilsson model is generally quite successful in describing the gross features of the level spectra of these transitional nuclei. The observed variations in level ordering and spacing accompanying changes in nuclear deformation and in neutron number are discussed. (Diss. Abstr. Int., B)

9650 ORIENTATION PARAMETERS FOR LOW-TEMPERATURE NUCLEAR ORIENTATION. Krane, K. S. (Los Alamos Scientific Lab., NM). Nucl. Data, Sect. A; 11: No. 5, 407-431 (Apr 1973).

A formulation is presented for the tensor components, B_λ, which characterize the magnetic substate population distribution of a nuclear spin system cooled to ultralow temperatures and subjected to a static magnetic dipole or electric quadrupole field. The choice of the phase of the B_λ is discussed, and comparisons are made with other descriptions of the oriented ensemble of nuclear spins. A table of values of the B_λ is presented for various energy splittings of the magnetic substates, and formulas are given which are good approximations for small and for large energy splittings. (2 figures, 1 table) (auth)

9651 TWO-QUASIPARTICLE STATES AND THE MICROSCOPIC COMPOSITION OF $K^\pi = 2^+$ COLLECTIVE EXCITATIONS IN ^{182}W AND ^{184}W. Kleinheinz, P. (Univ. of Copenhagen); Daly, P. J.; Casten, R. F. Contract AT(40-1)-2434. Nucl. Phys.; A208: No. 1, 93-118(1973).

Energy levels of ^{182}W and ^{184}W were investigated by (d,p), (d,t) and (^{3}He,α) reactions on enriched ^{183}W targets. In the deuteron-induced reactions, the reaction products at 60°, 90°, and 125° were magnetically analyzed, and approximate l-transfer values were deduced from the cross-section ratios at these angles. The (^{3}He,α) measurements provided important complementary data, locating several ^{182}W states populated with l = 6 transfer. The two-neutron configurations identified include $^9/_2$[624], $^1/_2$[510] $K^\pi = 4^-$ and 5^-, $^3/_2$[512], $^1/_2$[510] $K^\pi = 2^+$ and 1^+, and tentatively $^1/_2$[521], $^1/_2$[510] $K^\pi = 1^+$ in ^{182}W and $^{11}/_2$[615], $^1/_2$[510] $K^\pi = 5^-$ and (6^-), $^7/_2$[503], $^1/_2$[510] $K^\pi = 3^+$ and (4^+), and $^3/_2$[512], $^1/_2$[510] $K^\pi = 2^+$ and 1^+ in ^{184}W. The results also provide valuable insight into the microscopic structure of the γ vibrations and higher-lying $K^\pi = 2^+$ excitations in these nuclei, and made possible a detailed test of the predictions of microscopic calculations. The analysis indicates that the distinct difference in the observed collective character of the higher-lying $K^\pi = 2^+$ excitations in the two nuclei is associated with the N = 108 energy gap in the Nilsson diagram. (9 figures, 7 tables) (auth)

9652 YRAST STATES ON THE ASYMMETRIC ROTOR MODEL. Sugawara-Tanabe, K. (Tokyo Univ.); Tanabe, K. Nucl. Phys.; A208: No. 2, 317-332(1973).

The properties of the high-spin states in the deformed nuclei are well accounted for in terms of the asymmetric rotor model. In particular it is powerful in explaining the fast E2 transition time and the characteristics of the level population in the yrast region. The expression of the yrast line is analytically derived for the even-mass nucleus. So long as the spin-orbit force is weak enough, the effect of the asymmetric field for a single nucleon gives an energy scheme like a $^1/_2$-band due to the complete quenching of orbital angular momentum. Thus the yrast line for this case is also predicted asymptotically at very high-spin states. (auth)

9653 ISOMERIC E1 AND M1 TRANSITIONS IN ^{177}Ta AND IN NEIGHBORING ODD-A Lu AND Ta ISOTOPES. Schilling, K. D.; Andrejtscheff, W.; Dubbers, F.; Manfrass, P. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A208: No. 2, 418-428(1973).

Delayed γ-ray spectra as well as time distributions were measured applying the r.f.-γ method and the method of delayed γ-γ coincidences. Using the reaction ^{175}Lu(α,2n)^{177}Ta, the half-lives of the levels at 70.6 and 73.6 keV in ^{177}Ta were determined as $T_{1/2}$ = 80 ± 10 ns and $T_{1/2}$ = 370 ± 50 ns, respectively. In further experiments, upper limits for the lifetimes of the $^9/_2^-$[514] and $^5/_2^+$[402] states in ^{171}Lu and ^{173}Lu were estimated. Comparisons of the experimental half-lives to Weisskopf and Nilsson model predictions are performed taking into account pairing correlations. For the calculations, a modified Nilsson Hamiltonian was used. The hindrance factors obtained are summarized together with those deduced for corresponding transitions in neighboring odd-proton nuclei. From the experimental results in ^{177}Ta, conclusions were drawn on the possible value of the constant k_2 occurring in the magnetic dipole operator. (auth)

9654 INTERPRETATION OF NUCLEON EMISSION FROM THE BOMBARDMENT OF ^{181}Ta WITH PROTONS. Birattari, C.; Gadioli, E.; Grassi Strini, A. M.; Strini, G.; Tagliaferri, G. (Univ., Milan). Lett. Nuovo Cim.; 7: No. 3, 101-107(19 May 1973).

An analysis is made of experimental excitation functions of (p,3n), (p,4n), (p,pn), and (p,p2n) reactions on ^{181}Ta in the framework of the pre-equilibrium emission model. It is found that the fraction of total proton reaction cross section accounted for by the preequilibrium emission of neutrons and protons amounts to as much as 90%. (LBS)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 9548, 9575, 9588, 9589, 9598, 9627, 9646, 9647, 9682, and 10026.

9655 (JINR-P6-7003) LEVELS IN ^{209}At, ^{207}At, AND ^{205}At. Kempisty, T.; Korman, A.; Morek, T.; Peker, L. K.; Nguen Tat-To; Kharatym, Z.; Chojnacki, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The gamma rays accompanying the beta decay of ^{209}Rn, ^{207}Rn, and ^{205}Rn, produced in the reactions $^{nat.}$Tl(^{11}B,5n) ^{209}Rn, ^{197}Au(^{15}N,5n) ^{207}Rn, and ^{197}Au(^{15}N,7n)^{205}Rn, were investigated. On the basis of gamma-gamma coincidence measurements the level schemes of ^{209}At, ^{207}At, and ^{205}At are presented. (9 figures, 3 tables) (auth)

9656 (UCID-16258, p 3) TRANSMISSION DATA ANALYSIS FOR NEUTRONS ON ^{207}Pb. Phillips, T. W.; Berman, B. L. 25 Apr 1973.

In status report to USNDC.

9657 (USNDC-3, pp 20-22) THRESHOLD PHOTONEUTRON RESONANCES FROM ^{207}Pb(γ,n)^{206}Pb. Medsker, L. R.; Jackson, H. E.; Toohey, R. E. (Argonne National Lab., Ill.). 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24-26 October 1972.

9658 STUDY OF THE EFFECTIVE SPIN AND ORBITAL MAGNETIC MOMENTS OF NUCLEONS. Nagamiya, S. (Inst. of Physical and Chemical Research, Wako, Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 66: No. 3, 39-140(Sep 1972).

The g-factors of several high-spin isomeric states of ^{210}Po, ^{208}Po, ^{206}Po, ^{92}Mo, ^{90}Zr, ^{42}Ca were determined. Time-differential perturbed-angular-distribution method and stroboscopic resonance method were used in the experiment, in which the aligned isomeric states were populated by (particle, xn) reactions in microscopic beam bursts from a cyclotron. Quantitative deduction of the effective g_l- and g_s-factors of the nucleons is made by use of these results. Firstly, the core-polarization effect and the effect of the two-body $\vec{L} \cdot \vec{S}$ force on the g-factor are investigated in order to deduce the g_l- and g_s- values. It has turned out from the analysis that (i) the g_l-factor of the proton is about 10% larger than 1, (ii) the relative change of the observed g-factors for the j^n-states is well accounted for by the core polarization theory, but (iii) the absolute values of the observed g-factors are explained well only if we take into account the anomaly of the g_l-factor, and that (iv) the change in the g-factor in going from the ground state of ^{41}Ca to the 6^+ of ^{42}Ca is interpreted as being due to a large mixing of core-excited deformed states into the ^{41}Ca ground state. Next, the higher-order configuration-mixing effect on the g-factor is investigated in order to extract such parts in δg_l and δg_s that are ascribed to the change in the magnetic moment operator. In various mass regions it was found that δg_l(proton) = 0.20 ± 0.10 and δg_l(neutron) = −0.15 ± 0.10, which are compatible with the values predicted by the mesonic exchange theory. (auth)

9659 INTERNAL CONVERSION OF HIGH MULTIPOLARITY TRANSITIONS IN HEAVY NUCLEI. Coppage, D. L. Lafayette, IN; Purdue Univ. (1972). 223p. University Microfilms Order No. 73-6002.

Thesis (Ph. D.).

The particle parameters of the M4 transitions in ^{207}Pb and ^{117}Sn were measured by angular correlation methods. In ^{207}Pb the γ-γ angular correlation measurement of the 1063 M4-570 E2 cascade confirmed an earlier report of a small admixture of E2 in the 1064 M4 by giving as a value of the mixing ratio, δ(E5/M4) = −0.022 (0.006). With this mixing ratio taken into account, the values of the K- and L-shell b_2 particle parameters for the 1063 M4 transition are reported as $b_2(K) = 1.037(0.013)$ and $b_2(L) = 1.017(0.029)$. In addition, the K- and L-shell b_2 particle parameters for the 570 E2 transition were measured with the results: $b_2(K) = 1.201(0.036)$ and $b_2(L) = 1.08(0.10)$. Because of the recursion relation for higher-order particle parameters, the measurement of the b_4 particle parameters is equivalent to a measurement of b_2 parameters. In this case the analysis of the b_4 particle parameters confirms the directly measured values for b_2 but with a considerably larger error. In the case of ^{117}Sn, the K-γ and (L + M)-γ angular correlations of the 156 M4-159 M1(+E2) cascade were measured. Scattering in the source presented a problem, but with reasonable assumptions about the K-γ correlation, the (L + M)-shell b_2 particle parameter is $b_2(L + M) = 0.98(0.02)$. The overall agreement of the measured particle parameters with the theory is good. The 30.8 M1(+E2)-98.5 M1(+E2) γ-γ angular correlation in ^{195}Pt was also measured and gave $A_{22}(\gamma\gamma) = 0.039(0.005)$. Using e-$\gamma$ angular correlation data in the literature, the mixing ratios for each transition were deduced to be $\delta_{30.9}$(E2/M1) = −0.008(0.004) and $\delta_{98.5}$(E2/M1) = 0.08(0.03). In addition, a self-consistent summary of basic directional correlation theory with internal conversion is made available. (Diss. Abstr. Int., B)

9660 TARGET EXCITATIONS AND HIGHER-ORDER CORRECTIONS TO THE OPTICAL MODEL POTENTIAL FOR PRO-

TONS. Rao, C. L. Knoxville, TN; Univ. of Tennessee (1972). 163p. University Microfilms Order No. 73-12,431.
Thesis (Ph. D.).

The second-order effects in the optical-model potential for 30-MeV protons incident on ^{40}Ca and ^{208}Pb were investigated by explicitly constructing the nonlocal optical-model potential. Target polarization was taken to be the source of the nonlocal second-order potential. The excited states of the target were represented by collective vibrational levels. The energy-weighted sum rules were used to exhaust the total transition strength of a given multipole, thereby incorporating additional levels of a given multipole that were not experimentally observed. The proton scattering was exactly calculated by solving the Schrodinger equation for the nonlocal optical potential. The resulting elastic differential cross sections and absorption cross sections were subjected to conventional optical-model analysis in order to obtain local potentials, phase-equivalent to the calculated nonlocal potentials. The real potential contributions to the second-order optical potential were found to be small. In the case of ^{40}Ca it was possible to obtain 75% of the experimental absorption by including the levels postulated by energy-weighted sum rules, in addition to the experimentally observed levels. For ^{208}Pb it was not possible to find a local potential, phase-equivalent to the calculated nonlocal potential, because of the strong L dependence of the nonlocal potentials. The energy dependence of the local equivalents of the real potential and the surface imaginary potential was found to agree approximately with experiment. The nonlocal second-order potential for Pb tended to enhance the optical-model wave amplitudes in the nuclear interior compared to those from the local equivalent potential. (Diss. Abstr. Int., B)

9661 SPINS OF LEVELS IN ^{194}Pt. Singh, B.; Johns, M. W. (McMaster Univ., Hamilton, Ont.). Nucl. Phys; A208: No. 1, 55-60(1973).

Selected cascades in the level scheme of the ^{194}Pt nucleus were studied by the γ-γ directional correlation method, the spins of the 924-, 1513-, 1623-, 1672-, and 1798-keV levels were determined to be 3, 2, 2, 2, and 1, respectively. The multipole mixing ratios of the 301-, 594-, 1184-, and 1295-keV γ transitions were determined, and a number of B(E2) ratios are compared with theory. (1 figure, 2 tables) (auth)

9662 K CONVERSION COEFFICIENT NEAR THRESHOLD OF THE M3 TRANSITION IN ^{191}Os. Loeweneck, P.; Martin, B. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Z. Phys.; 259: No. 1, 61-66(1973).

The K conversion coefficient of the 74.38-keV M3 isomeric transition in ^{191}Os was measured with a curved crystal spectrometer of DuMond type. The experimental result $\alpha_K = 106 \pm 11$, is in agreement with theoretical calculations if the dynamic correction coefficient $\lambda = 9.4 \pm 0.5$ is taken into account. (5 figures, 1 table) (auth)

9663 SUB-COULOMB DEUTERON BREAK-UP AND THE NEUTRON-NUCLEUS INTERACTION. Bauer, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Trautmann, D.; Zoran, V. Nucl. Phys.; A208: No. 2, 261-268(1973).

Low-energy deuteron break-up on heavy nuclei is treated paying special attention to the neutron-nucleus interaction. The neutron-nucleus elastic scattering phase shift, the only quantity through which the neutron-nucleus interaction enters into the calculations, is split into an energy-averaged part described by the optical model and a fluctuating part. Some calculations are given in order to illustrate the effects of the neutron-nucleus interaction, along with a comparison with recent experimental results, which shows a very good agreement. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 9589, 9609, 9627, and 9731.

9664 (AD-753542) X RAYS FROM FISSION. Moore, C. F.; Hoffman, G. W. (Texas Univ., Austin. Center for Nuclear Studies). 31 Dec 1972. Contract N00014-67-A-0126-0012. 20p. NTIS.

Activities pursued during the nine months of the contract X Rays from Fission are reported. A time-of-flight tube was constructed and tested. All effort is now being devoted to the extraction of isotopic fission yields from the data of energy-time-of-flight-induced L-x-ray coincidence experiments. The test and preliminary data obtained are quite promising. (auth)

9665 (JEN-257) LEVEL SCHEME OF ^{223}Fr. Gaeta, R.; Gonzalez, J. A.; Gonzalez, L.; Roldan, C. (Junta de Energia Nuclear, Madrid (Spain). Division de Fisica). 1972. 115p. (In Spanish). Dep. NTIS (U. S. Sales Only) $7.75.

A study was made of the decay of ^{227}Ac to levels of ^{223}Fr, by means of Si surface barrier alpha spectrometers and Ge(Li) gamma spectrometers. The rotational bands $\frac{1}{2}$-(541$\downarrow$), $\frac{1}{2}$-(530$\uparrow$), and $\frac{3}{2}$-(532$\downarrow$) were identified, as well as two octupole bands associated with the ground-state band. The results obtained indicate that the unified model is applicable in this intermediate region of the nuclide chart. (31 figures, 7 tables, 150 references) (auth)

9666 (JINR-E7-6970) TRANSFER REACTIONS IN THE INTERACTION OF ^{40}Ar WITH ^{232}Th. Artukh, A. G.; Gridnev, G. F.; Mikheev, V. L.; Volkov, V. V.; Wilczynski, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

Transfer reactions in the bombardment of ^{232}Th target with 297 and 388 MeV ^{40}Ar ions were studied. The energy spectra, angular distributions and the cross sections for the formation of products, having atomic numbers $5 \leq Z \leq 20$, were measured. In the energy spectra of the reaction products broad peaks, having energies in the vicinity of the output Coulomb barrier height, were observed along with the quasielastic ones. The dependence of the partial angular distribution of the light products on the reaction Q-value was determined. The observed partial angular distributions were analyzed by applying the Strutinsky model. The total cross sections of light product formation were found to be 1100 mb and 2400 mb for the ^{40}Ar energies E = 297 and 388 MeV, which give the values of the critical angular momentum of 102$\hbar$ and 94$\hbar$ respectively for the two cases. (auth)

9667 (JINR-E11-6969) RECONSTRUCTION OF PARTICLE MULTIPLICITY DISTRIBUTIONS USING THE METHOD OF STATISTICAL REGULARIZATION. Dakowski, M.; Lazarev, Yu. A.; Turchin, V. F.; Turovtseva, L. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The problem of reconstruction of particle multiplicity distributions from experimental data is discussed. Because of statistical errors involved in the data the problem of reconstruction is "incorrectly posed" which results in the oscillatory behavior of the direct solution when the detection efficiency is substantially lower than 100%. It is shown that the method of statistical regularization used reconstructs the real distribution and allows one to estimate the rms errors of the results for $\epsilon \gtrsim 25\%$. The possibilities of the method are examined on the basis of the measurements of the multiplicity distribution of neutrons from spontaneous fission of ^{244}Cm. The application of the method to determination of the multiplicity distributions for three Fm isotopes is presented. (auth)

9668 (JINR-P7-7022) COULOMB EXCITATION OF SPONTANEOUSLY FISSIONING ISOMERS BY HEAVY IONS. Gangrskii, Yu. P.; Markov, B. N.; Nguyen Cong Khanh; Oganesyan, Yu. Ts.; Pham Zuy Hein (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The results of experiments on the Coulomb excitation of a spontaneously fissioning isomer of ^{238}U with the half-life of 200 ns are presented. Upper limits for cross sections are found to be 10^{-31} cm^2 for 750-MeV ^{136}Xe ions and 10^{-33} cm^2 for 60-MeV ^{12}C ions. Different ways of population of the isomeric state at the Coulomb excitation are discussed. (2 figures, 1 table) (auth)

9669 (UCID-16258, p 2) THERMAL-NEUTRON FISSION CROSS SECTIONS OF ^{251}Cf AND ^{255}Fm. Ragaini, R. C.; Hulet, E. K.; Lougheed, R. W.; Wild, J. F. 25 Apr 1973.
In status report to USNDC.

9670 (USNDC-3) REPORTS TO THE U. S. NUCLEAR DATA COMMITTEE MEETING AT NATIONAL BUREAU OF STANDARDS, 24-26 OCTOBER 1972. Jackson, H. E. (comp.) (Argonne National Lab., Ill.). 1973. 230p. (EANDC(US)-176-U; INDC(USA)-50-U; CONF-721081-). Dep. NTIS $3.00.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

Research on nuclear physics including microscopic neutron cross sections, charged-particle cross sections, gamma production, decay, nuclear structure, and proton and alpha-particle cross sections done at various laboratories is summarized. Portions of the document containing significant amounts of new information are separately title listed. (JFP)

For title listings of individual portions see: 9510, 9511, 9525, 9526, 9535-9540, 9566-9569, 9580-9583, 9597-9600, 9611-9614, 9638-9642, 9657, 9671-9683, and 10026.

9671 (USNDC-3, pp 2-3) NEUTRON RESONANCE PARAMETERS OF ^{242}Pu BELOW 500 eV. Simpson, F. B. (Aerojet

Nuclear Co., Idaho Falls, ID); Simpson, O. D.; Miller, H. G.; Harvey, J. A.; Hill, N. W. 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9672 (USNDC-3, pp 4-7) ^{244}Cm TOTAL, CAPTURE, AND FISSION CROSS SECTIONS BELOW 530 eV. Simpson, O. D. (Aerojet Nuclear Co., Idaho Falls, ID); Simpson, F. B.; Young, T. E.; Harvey, J. A.; Hill, N.; Benjamin, R. W. 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9673 (USNDC-3, pp 43-44) SPINS OF LOW ENERGY NEUTRON RESONANCES OF ^{235}U. Reddingius (Brookhaven National Lab., Upton, NY); Postma; Olsen, C. E.; Rorer; Sailor. 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9674 (USNDC-3, pp 99; 101) INVESTIGATION OF γ-RAY EMISSION PRECEDING ISOMERIC FISSION IN ^{243}Pu. Browne, J. C.; Bowman, C. D. (Univ. of California, Livermore). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9675 (USNDC-3, pp 116-117) PROMPT NEUTRONS FROM SPONTANEOUS FISSION OF ^{257}Fm. Veeser, Hemmendinger; Farrell. (Los Alamos Scientific Lab., NM). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9676 (USNDC-3, pp 118-119) FISSION NEUTRON SPECTRA OF ^{238}U, ^{235}U, AND ^{239}Pu AT 1.85 MeV EXCITATION. Auchampaugh; Drake; Ragan. (Los Alamos Scientific Lab., NM). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9677 (USNDC-3, pp 122-124) ^{240}Pu(n,γ)^{241}Pu. Jurney. (Los Alamos Scientific Lab., NM). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9678 (USNDC-3, pp 127-128) NUCLEAR RESEARCH RELATED TO SAFEGUARDS: REVISED LASL DELAYED-NEUTRON YIELD DATA. Evans, A. E.; Thorpe, M.; Krick, M. S. (Los Alamos Scientific Lab., NM). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9679 (USNDC-3, pp 129-132) MeV NEUTRON TOTAL CROSS SECTIONS. Schwartz, R. B.; Schrack, R. A.; Heaton, H. T. II; Camarda, H. S. (National Bureau of Standards, Washington, DC). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9680 (USNDC-3, pp 134-135) MEASUREMENT OF ^{235}U AND ^{238}U FISSION CROSS SECTIONS FOR ^{252}Cf SPONTANEOUS FISSION NEUTRONS. Grundl, J. A.; Spiegel, V. Jr.; Eisenhauer, C. M. (National Bureau of Standards, Washington, DC). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9681 (USNDC-3, pp 143-144) VALUES OF THE AVERAGE FISSION CROSS SECTION OF ^{235}U. Gwin, R.; Silver, E. G.; Ingle, R. W. (Oak Ridge National Lab., TN). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9682 (USNDC-3, pp 164-165) CAPTURE MEASUREMENTS NEAR 24-keV WITH IRON-FILTERED BEAMS. Block, R. C.; Kaushal, N. N.; Hockenbury, R. W. (Rensselaer Polytechnic Inst., Troy, NY). 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9683 (USNDC-3, pp 166-169) TEMPERATURE-DEPENDENT TRANSMISSION AND SELF-INDICATION MEASUREMENTS UPON DEPLETED U IN THE UNRESOLVED REGION. Byoun, T. Y. (Rensselaer Polytechnic Inst., Troy, NY); Block, R. C.; Semler, T. 1973.
From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).
In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

9684 EXISTENCE OF A CRITICAL CHARGE FOR SUPER-HEAVY NUCLEI. Bawin, M.; Lavine, J. P. (Univ., Liege). Nuovo Cim.; 15A: No. 1, 38-44(1 May 1973).
Electron and positron scatterings off a superheavy nucleus are studied in a model where spin effects are ignored. Using a method due to Case, the finite size of the nucleus is taken into account through a free parameter which occurs in the formal solution of the Klein-Gordon equation with a singular $\alpha Z/r$ potential ($\alpha Z > 1/2$). It is found that the positron wave functions vanishes at $|E|_{positron} = m_e$, thus making it impossible for the nucleus to create electron-positron pairs spontaneously since the minimum electron energy allowable is $E_{electron} = -m_e$. As a consequence, no grounds in the framework of a single-particle equation for the existence of a critical charge for superheavy nuclei were found, contrary to the conjecture of several authors. (auth)

9685 ATTEMPT AT EXPERIMENTAL DETECTION OF (n,γf) PROCESS DURING FISSION OF ^{239}Pu BY RESONANCE NEUTRONS. Zen Chan Bom; Panteleev, Ts.; Tyan San Khak (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 1, 82-85(Jan 1973). (In Russian).
The variations in the multiplicity of prompt γ rays were measured during fission of ^{239}Pu by resonance neutrons. The measurements were conducted by the time-of-flight method at the JINR pulsed fast reactor with a resolution of ~220 n/m. The difference between the average widths of the (n,γf) process during fission through the compound states with $I^{\pi} = 0^+$ and 1^+ did not exceed ~4 MeV. (1 figure, 1 table) (tr-auth)

9686 COINCIDENCE STUDIES OF ^{252}Cf SPONTANEOUS FISSION FRAGMENTS. Hopkins, F. F. Austin, TX; Univ. of Texas (1972). 112p. University Microfilms Order No. 73-7574.
Thesis (Ph. D.).
A series of coincidence experiments was performed to learn something of the γ-transitions in direct and post beta decay products from the spontaneous fission of ^{252}Cf. Two x-ray-γ-ray coincidence runs were made, one to locate γ-rays in the energy range 45 to 200 keV and a second one for the range 150 to 1000 keV. Approximately 60 new isotopic identifications resulted from the Z-value information of these experiments in conjunction with previous mass assignments. Two γ-ray-γ-ray coincidence experiments were then performed, one in close geometry and one in an extended geometry where one of the two direct fragments from a binary event was partially shielded from two Ge(Li) detectors. According to gates set on the low energy (48 to 200 keV) spectrum from a high resolution detector, coincident γ-rays from a larger detector were sorted out. The results include the placement of several γ-cascades in specific isotopes. In addition, partial decay schemes for ^{105}Mo, ^{109}Ru, ^{111}Ru, and ^{146}La were suggested. (Diss. Abstr. Int., B)

9687 MEASUREMENT OF THE FISSION CROSS SECTION OF PLUTONIUM-241 RELATIVE TO URANIUM-235. Kaeppeler, F.; Pfletschinger, E. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Nucl. Sci. Eng.; 51: No. 2, 124-129(Jun 1973).
The fission cross-section ratio ^{241}Pu:^{235}U was measured in the neutron energy range from 5 keV to 1.2 MeV with an accuracy between 3 and 4%. The neutron energy was determined by the time-of-flight method. Two identical gas scintillation chambers were used to detect the fission events. The present measurements were carried out at sufficiently fine energy intervals to show for the first time the detailed shape of the fission cross-section ratio. In contrast to the results of other authors, a distinct structure was found. A comparison with an evaluation by Davey of previous

data shows a systematic difference in shape up to 10% between 30 and 400 keV. At higher energies the evaluation generally agrees with the new data except in the region between 900 and 1000 keV, where the values of this work indicate a significant dip in the cross-section ratio. (2 figures, 3 tables) (auth)

9688 HIGH RESOLUTION MEASUREMENTS OF NEUTRON-INDUCED FISSION CROSS SECTIONS FOR ^{233}U, ^{235}U, ^{239}Pu, AND ^{241}Pu BELOW 30 keV. Blons, J. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Sci. Eng.; 51: No. 2, 130-147(Jun 1973).

Neutron-induced fission cross sections of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu were measured up to 30 keV. These measurements were performed with samples cooled down to liquid-nitrogen temperature and with a nominal resolution of 1 ns/m, by using the 60-MeV Saclay LINAC as a pulsed-neutron source. The agreement with previously published results is within 3% for ^{235}U in the energy range 60 eV to 10 keV, and 6% for ^{233}U below 1220 eV. For ^{239}Pu and for ^{241}Pu in the energy ranges 0.7 to 7 keV and 10 to 20 keV, the agreement is also within 6%. Total errors are a function of target material and incident neutron energies and, hence, are estimated to lie between 3 and 7%. The existence of an intermediate structure is demonstrated in the fission cross section of ^{239}Pu. (15 figures, 9 tables) (auth)

9689 PROMPT X-RAY MEASUREMENTS FROM SPONTANEOUS FISSION OF ^{252}Cf. St. Laurent, Rodrigue. Austin, TX; Univ. of Texas (1972). 64p. University Microfilms Order No. 73-7636.

Thesis (Ph. D.).

A two-parameter (K x-ray, K x-ray) coincidence measurement was made using a Si(Li) detector and a Ge(Li) detector. This measurement yielded the result that there is a large number of coincident events with x-rays from the same Z element as well as with x-rays from the complementary fission product; (e.g., Cs K x-rays are in coincidence with both the complementary Tc K x-rays and the Cs K x-rays). The various possibilities one may consider are: K x-ray production by the primary fission process followed by internal conversion. Multiple K x-ray production in the stopping process of the fission products, K-shell ionization resulting from β-decay of the fission fragments followed by internal conversion in the same fragment, and multiple internal-conversion processes from cascading transitions. Each of these four possible causes for self-coincident K x-ray production was explored. A similar investigation, using two Si(Li) detectors, was made concerning the L x-ray production of the fission. Results indicate that self coincidences are comparable to the number of complementary coincidences. This is due to the fact that probably many L x-rays are produced when the fragments are stopped. (Diss. Abstr. Int., B)

9690 NUCLEAR SPECTROSCOPIC STUDIES OF ^{252}Es. Fields, P. R. (Argonne National Lab., IL); Ahmad, I.; Barnes, R. F.; Sjoblom, R. K.; McHarris, W. C. Nucl. Phys.; A208: No. 2, 269-286(1973).

The decay scheme of ^{252}Es was investigated with high-resolution semiconductor detectors in conjunction with coincidence techniques. The half-life of ^{252}Es was measured by following the decay of the α-count rate associated with ^{252}Es decay and was found to be 350 ± 50 d. The electron capture and α-decay branchings were measured to be (22 ± 2)% and (78 ± 6)%, respectively. The EC decay almost entirely populates a level at 969.8 keV in ^{252}Cf with a log ft value of 8.9. This state was identified as the two-neutron state $\{n[613]7/2^+; n[620]1/2^+\}3^+$. A $K^\pi = 2^-$ band was identified at 830.8 keV. A rotational band built on an 804.8 keV level was interpreted as the γ-vibrational band $K^\pi = 2^+$. On the basis of the observed log ft value, the ground state of ^{252}Es was given an assignment of $\{n[613]7/2^+; p[521]3/2^-\}5^-$. The favored α-transition of ^{252}Es was found to populate a level at 590 keV in ^{248}Bk. The ground state of ^{248}Bk was given a spin-parity assignment of 6^+ with the two-quasiparticle configuration $\{n[734]3/2^-; p[521]3/2^-\}$. (auth)

9691 ALPHA-DECAY OF 39.3-h ^{254m}Es ISOMER. Ahmad, I.; Diamond, H.; Milsted, J.; Lerner, J.; Sjoblom, R. K. (Argonne National Lab., IL). Nucl. Phys.; A208: No. 2, 287-301 (1973).

Mass-separated samples of ^{254m}Es were used to investigate its α-decay scheme. Twelve α-groups were identified in a spectrum measured with the Argonne magnetic α-spectrometer. The favored α-transition populates a 211.8 keV level in ^{250}Bk and four members of its rotational band were observed. A three-parameter α-γ time coincidence experiment showed that the 211.8 keV level decayed by three routes: two were prompt and one was delayed. The delayed γ-rays (50.07, 71.30, 90.7, 104.0, 126.0 and 175.7 keV) decayed with a 42 ± 2 ns half-life. The energies of the prompt γ-rays were 79.90, 96.3, 177.3 and 211.8 keV. From an α-ce$^-$ coincidence experiment the the multipolarity of the 211.8 keV transition was deduced to be E1. The α-branching was determined from an α-singles spectrum and was found to be 0.33 ± 0.01%. From the results of the present investigation and the known properties of ^{250}Bk and ^{254m}Es, the 211.8 keV state in ^{250}Bk and the ^{254m}Es ground state were given $\{n[622]3/2^+; p[633]1/2^+\}2^+$ assignment. Other levels in ^{250}Bk were postulated at 104.0 (and its rotational member at 125.3), 131.9 and 175.3 keV and these were given tentative assignments of $\{n[620]1/2^+; p[521]3/2^-\}1^-$, $\{n[620]1/2^+; p[633]7/2^+\}3^+$ and $\{n[613]7/2^+; p[633]7/2^+\}0^+$ (with I = 1), respectively. The splitting energies between the parallel and antiparallel coupled states were calculated with a Gaussian potential for the residual neutron-proton interaction and were found to be in agreement with the experimental values. A precise measurement of the energies and intensities of γ-rays and K x-rays associated with the ^{254m}Es β^- decay was also made. The Fm $K_{\alpha 2}$ and $K_{\alpha 1}$ energies were found to be 115.280 ± 0.015 and 121.065 ± 0.015 keV, respectively. (auth)

9692 DECAY OF THE NEUTRON DEFICIENT PLUTONIUM ISOTOPES 232, 233, AND 234. Jaeger, U.; Muenzel, H.; Pfennig, G. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys.; 259: No. 4, 337-343(1973). (In German).

The plutonium isotopes ^{232}Pu, ^{233}Pu and ^{234}Pu were produced by (α,xn) reactions with ^{233}U. After a chemical separation their decay was studied by γ-ray and α spectroscopy. For ^{233}Pu twenty-seven γ-ray energies and intensities were measured, and a decay scheme is proposed. An additional α transition was detected for ^{232}Pu. The half-lives were determined for all three isotopes. (5 figures, 1 table) (auth)

9693 THERMAL-NEUTRON CAPTURE CROSS-SECTIONS AND CAPTURE RESONANCE INTEGRALS OF ^{253}Es. Harbour, R. M.; MacMurdo, K. W. (E. I. du Pont de Nemours and Co., Aiken, SC). J. Inorg. Nucl. Chem.; 35: No. 6, 1821-1825(Jun 1973).

The partial thermal-neutron capture cross sections (σ_{2200}) and capture resonance integrals (I_c) of 20.47-d ^{253}Es to produce 39.3-h ^{254m}Es and 276-d ^{254g}Es were measured relative to ^{59}Co standards. The number of atoms of ^{254m}Es produced per ^{253}Es target atom was determined by measuring the alpha activity of the 3.24-h ^{254}Fm daughter relative to ^{253}Es alpha activity; the number of ^{254g}Es atoms produced per ^{253}Es target atom was determined by analysis of ^{254g}Es alpha activity relative to ^{253}Es alpha activity following appreciable decay of ^{253}Es. The measured values for ^{253}Es are: σ_{2200} (to ^{254m}Es) = 155 ± 20b, σ_{2200} (to ^{254g}Es) 3b, I_c (to ^{254m}Es) = 3009 ± 168b (0.412 eV cutoff) and I_c (to ^{254g}Es) = 4299 ± 218b (0.412 eV cutoff). (auth)

9694 POLAR EMISSION: TRIPARTITION OR EVAPORATION. Piasecki, E.; Blocki, J. (Inst. of Nuclear Research, Swierk, Poland). Nucl. Phys.; A208: No. 2, 381-409(1973).

Measurements were made of the energy angular distribution of α-particles emitted during thermal-neutron fission of ^{235}U. After the extrapolation of the α-particle energy spectra the FWHM of the angular distribution was determined to be 20.5° ± 2°. About 5% of all α-particles, being collimated around the fission axis ("polar α-particles"), are not emitted from the neck of the fissioning nuclei. The mean energy of polar α-particles in the laboratory system is equal to 23 ± 1 MeV. Assuming that the α-particles are evaporated in flight from the excited fragments, the mean experimental mass of the α-emitting light fragments can be reproduced theoretically. Similarly, the α-particle energy spectrum and the intensity of emission from the heavy fragments are explained quantitatively without parameter fitting. The energy spectrum of α-particles going along the light-fragment trajectory can be explained if the fragment deformation is taken into account. The intensity of such α-particles and the large anisotropy in the angular distribution of the polar α-particles can be explained only by assuming a very low value of the moment of inertia or a high angular momentum of the fragments. Suggestions are given for further experiments. (auth)

9695 RADIOCHEMICAL YIELD IN THE SPONTANEOUS FISSION OF ^{238}U. Purkayastha, B. C.; Bhattacharyya, D. K. (Saha Inst. of Nuclear Physics, Calcutta). J. Inorg. Nucl. Chem.; 35: No. 6, 1793-1796(Jun 1973).

The radiochemical yields of ^{133}I and of ^{99}Mo have been found to be 5.6 ± 0.4 and 5.7 ± 0.3%, respectively, based on Segré's half-life for the spontaneous fission of ^{238}U. In both cases the products were of high radiochemical purity, and the final data are therefore reliable. (auth)

9696 ANGULAR AND ENERGETIC FEATURES OF ^{4}He AND ^{6}He PARTICLES FROM ^{239}Pu THERMAL FISSION. Fossati, F.; Petronio, C.; Pinelli, T. (Univ., Pavia, Italy). Nucl. Phys.; A208: No. 1, 196-206(1973).

Energy spectra and angular distributions with respect to the direction of flight of the light fragment were measured for ^{4}He and ^{6}He particles emitted in the thermal-neutron-induced fission of

^{239}Pu. Such a measurement for particles heavier than an α particle has not been reported up to now. Particle identification and energy measurements were performed by using solid state detectors. Gaussian fits of the obtained distributions are reported, together with the experimental data. The most probable angles, θ_k, and relative FWHM are found to be $\theta_k = 84°$, FWHM = 24°, and $\theta_k = 86°$, FWHM = 23° for ^{4}He and ^{6}He angular distributions, respectively. Comments are made about the characteristics of the achieved angle/energy correlation. (6 figures, 3 tables) (auth)

9697 NUCLEAR CHARGE DISPERSION OF PRODUCTS IN THE LIGHT-MASS REGION FORMED IN THE FISSION OF ^{233}U BY PROTONS OF ENERGY 20 TO 85 MeV. Marshall, H.; Yaffe, L. (McGill Univ., Montreal). J. Inorg. Nucl. Chem.; 35: No. 6, 1797-1804(Jun 1973).

The independent formation cross sections of ^{95}Nb and ^{97}Nb and the cumulative yields of ^{95}Zr, ^{97}Zr and ^{99}Mo from the fission of ^{233}U by protons were determined radiochemically for bombarding energies of 20, 30, 40, 50, 60, 72 and 85 MeV, and charge dispersion curves were constructed from these cross sections. The displacements of the most probable charges from stability and the full-widths at half-maximum are very close to those found for the light-mass products of ^{235}U and ^{238}U in this energy range, and thus differ markedly from those for the charge dispersion of the heavy-mass products which show a marked dependence on the neutron-to-proton ratio of the target. Calculations indicate that, for a set of heavy isotopic fission targets, the extra neutrons appear in the heavy-mass fission fragment. (auth)

9698 CHARGE DISPERSION IN THE FISSION OF ^{238}U BY PROTONS OF ENERGIES 30 TO 160 MeV. Miller, L. D.; Yaffe, L. (McGill Univ., Montreal). J. Inorg. Nucl. Chem.; 35: No. 6, 1805-1819(Jun 1973).

Independent and cumulative formation cross sections in the fission of ^{238}U by protons of energy 30 to 160 MeV were determined for isotopes of antimony of A = 120 to 131. Charge-dispersion curves were constructed and these were corrected for the variation of N/Z_p as a function of A. The charge-dispersion curves showed an asymmetry when computer-fitted which disappeared when two overlapping Gaussians were used to fit the data. If these can be correctly interpreted by the two-mode fission hypothesis, the ratios of asymmetric to symmetric fission at 50 and 160 MeV would be 7.9 and 1.5, respectively. (auth)

Nuclear Theory

Refer also to abstract 9660.

9699 (COO-3001-39) RESEARCH IN THEORETICAL NUCLEAR PHYSICS. Progress Report and Renewal Proposal. Arima, A.; Brown, G. E.; Jackson, A. D.; Kuo, T. T. S. (State Univ. of New York, Albany. Research Foundation; State Univ. of New York, Stony Brook). 31 May 1973. Contract AT(11-1)-3001. 47p. Dep. NTIS $4.50.

An administrative-type research report and renewal proposal is presented. Reference is made in a number of the summaries contained herein to work which has already been published. The following board areas of interest are represented: fundamental interactions of nucleons, two- and three-nucleon systems, heavy nuclei and nuclear fission, and nuclear reactions. (RWR)

9700 (JINR-E4-7054) MODEL FOR THE DESCRIPTION OF THE FRAGMENTATION OF SINGLE- AND MANY-PARTICLE STATES OVER THE LEVELS OF AN ODD SPHERICAL NUCLEUS. Vdovin, A. I.; Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

A model for the description of the structure of intermediate-excitation-energy states and highly excited states in odd-mass spherical nuclei is considered. The process of fragmentation, which is responsible for the complication of the state structure with increasing excitation energy, is described by means of the interaction of quasi particles with different type phonons. Basic equations of the model suggested are derived. A method of calculating the density of highly excited states in odd-mass spherical nuclei is proposed. (auth)

9701 (JINR-P1-7033) RESONANCE WIDTH MEASUREMENT BY INTERFERENCE METHOD. Berezhnev, S. F.; Vertogradov, L. S.; Kopylov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The results of a numerical experiment on the possibility of measuring level widths of excited nuclei by the interference method are presented. (6 figures) (auth)

9702 (JINR-P4-6960) INFLUENCE OF THE FINITE SIZE OF ALPHA-PARTICLE ON ABSOLUTE ALPHA-DECAY WIDTHS FOR SPHERICAL NUCLEI. Kadmenskii, S. G.; Stratan, G.; Furman, V. I.; Kholan, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that taking into account of the finite size of the α particle leads to a decrease of the α-decay absolute probabilities by two-three orders of magnitude and also to the dependence of the relative α widths on the orbital momenta of the nucleons forming the α particle. The effect of the α-particle polarizability (which role increases with the L growth) is studied. In the framework of the superfluid model the absolute probabilities are calculated for the favored α transitions of more than 200 nuclei. The theoretical α widths turn out to be smaller than the experimental ones by a factor of 10, which is approximately constant for all the nuclei studied. (3 figures, 2 tables) (auth)

9703 (JINR-P4-6991) SAXON-WOODS POTENTIAL USED FOR DESCRIPTION OF THE BOUND STATES WHEN STUDYING THE PROCESS $\mu^- + (A,Z) \rightarrow (A-1, Z-1) + n + \nu$. Gareev, F. A.; Salganik, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that the use of the Saxon-Woods potential for description of the bound states of nucleons in a nucleus instead of the harmonic oscillator potential, used everywhere till now, does not introduce essential changes to the energy spectrum and asymmetry of the angular distribution of the process $\mu^- + (A,Z) \rightarrow (A-1, Z-1) + n + \nu$. (auth)

9704 (ORO-3948-5) PION INTERACTIONS AT MEDIUM ENERGIES. Progress Report. Allred, J. C.; Goodman, C.; Mayes, B. W. II (Houston Univ., Tex.). 1 Jun 1973. Contract AT(40-1)-3948. 14p. Dep. NTIS $3.00.

Continued progress was made in experimental and theoretical studies of nuclear structure and reaction mechanisms at intermediate energies. Experiments were performed at the Space Radiation Effects Laboratory (SREL) in Newport News, Virginia in the areas of proton and pion multiple scattering, Coulomb-nuclear interference scattering, $(\pi,2p)$ cross sections, π-nucleus total cross sections and small angle scattering, and pion activations of nuclei. During the year multi-particle final state experiments were begun on p-d breakup using 600 MeV protons. Quasi-free scattering and final state interaction cross sections have been measured. All of these experiments are preparatory to approved experiments at LAMPF. Development has continued on Cherenkov counters for particle identification and planning has proceeded for the biomedical experiments approved at LAMPF. During the year a portable laboratory was constructed in a Fruehauf trailer at Rice University and an on-line computer system installed that is especially designed for use with many multi-wire proportional counters, scintillators, and Cherenkov counters at LAMPF at high data rates. (auth)

9705 CONSISTENT TEST OF THE STRUTINSKY-NILSSON METHOD. Bassichis, W. H.; Tuerpe, D. R. (Lawrence Livermore Laboratory, Livermore, California 94550); Tsang, C. F.; Wilets, L. Phys. Rev. Lett. 30: No. 7, 294-297 (12 Feb 1973).

The Strutinsky method for extracting the shell corrections from Nilsson single-particle energies is tested consistently within the constrained Hartree-Fock (CHF) framework. It is shown that a Nilsson potential, fitted to the CHF single-particle energies at one deformation, reproduces the CHF level ordering at other deformation surprisingly well. The shell corrections obtained from the Nilsson single-particle energies via the Strutinsky method are shown, however, to be unreliable by 30% on the average. (auth)

9706 K^--NUCLEUS OPTICAL POTENTIAL. Alberg, M.; Henley, E. M.; Wilets, L. (Physics Department, University of Washington, Seattle, Washington 98195). Phys. Rev. Lett. 30: No. 7, 255-257 (12 Feb 1973).

A nonlocal, energy-dependent, K^--nucleus optical potential is derived by means of the independent pair approximation and a t-matrix method. Strong coupling of the K^--proton pair to the Y_0^* is taken into account. The effects of nonlocality and off-energy-shell behavior of the t matrix are found to be appreciable. Approximately equivalent local potentials are defined; they all differ significantly from the shape of the nuclear density in the surface region. Shifts and widths of levels in several light kaonic atoms are calculated and found to be in reasonable agreement with experiment. (auth)

9707 OFF-ENERGY-SHELL T MATRIX FOR LOCAL POTENTIALS WITH NONLOCAL SQUARE WELL CORE INTERACTION. Zohni, O. (International Center for Theoretical, Physics, Trieste, Italy). J. Math. Phys. (N.Y.) 14: No. 2, 205-208 (Feb 1973).

An analytic expression is obtained for the s-wave t matrix of a nonlocal square well core interaction combined with an outside local square well. The result is compared with the t matrix of the hard-core square well. In particular, the t matrix obtained is found to remain finite for large values of the energy parameter in contrast to the hard-core square well t matrix. (auth)

9708 CENTRE-OF-MASS MOTION, THE PAULI PRINCIPLE AND A GENERALIZED PSEUDOMETRIC. Ernst, D. J. (Instituto Politecnico Nacional, Mexico City). Nuovo Cim.; 15A: No. 1, 136-144(1 May 1973).

The method of introducing redundant variables into the quantum-mechanical many-body problem and solving the problem in a Hilbert space with a pseudometric is generalized. The advantage of this method is that it enables the Pauli principle to be simply expressed in terms of the set of redundant variables as antisymmetry under the exchange of any two co-ordinates while translational invariance is maintained through the pseudometric. This generalization of the pseudometric technique leads to a continuous set of methods of projecting a translationally invariant wave function from one that does not possess this invariance. This projection technique does not include the Gartenhaus and Schwartz transformation. The pseudometric approach also provides the Hamiltonian which the translationally noninvariant wave function must satisfy. (auth)

9709 DISCREPANCIES IN ICC CALCULATIONS FOR LOW-ENERGY TRANSITIONS. Martin, B.; Schule, R. (Max-Planck Institut fuer Kernphysik, Heidelberg). Z. Phys.; 259: No. 1, 9-13(1973).

Systematic comparison of the K–M_5 subshell ICC of Hager and Seltzer with calculations of this paper was performed for Z = 50, 60, 80, 100 and for E1–E4 and M1–M4 multipolarities and for conversion electron energies ranging from 1 to 1,500 keV. In most cases, the two sets of ICC agree within a few percent; for high multipolarities and very low conversion electron energies, however, discrepancies as large as 20 percent were observed. (1 figure, 2 tables) (auth)

9710 NUCLEAR BINDING BY THE ONE-PION EXCHANGE POTENTIAL. Calogero, F. (Univ., Rome); Palumbo, F. Lett. Nuovo Cim.; 6: No. 16, 663-667(21 Apr 1973).

Work on the nucleon–nucleon interaction containing two-body forces, the one-pion exchange potential (OPEP), saturation, and the possibility for an energetically favored, high-density, collapsed configuration is summarized. Attention is directed to the question "What is the threshold density beyond which the collapsing regime takes over?" by considering a nuclear matter computation performed with a two-nucleon interaction consisting only of an OPEP tail. Only if the threshold density is such that the nonrelativistic framework is still applicable does the effect have physical relevance. A variational calculation is done for "balanced" nuclear matter with a Slater determinant used as many-nucleon trial wave function. Graphs of kinetic and total energy per nucleon vs k_F are shown for R = 0.4 and 1.0 F. The kinetic energies per particle are such as to justify, as least for qualitative purposes, the validity of a nonrelativistic treatment. (1 figure) (RWR)

9711 FLUCTUATIONS IN THE STATISTICAL THEORY OF PRE-EQUILIBRIUM NUCLEAR REACTIONS. Gadioli-Erba, E.; Sona, P. G. (CISE, Milan). Lett. Nuovo Cim.; 6: No. 16, 659-662(21 Apr 1973).

The dominant effect in the statistical theory of pre-equilibrium nuclear reactions at excitation energies that are not too high is the intranuclear cascade process, in which at every step the number of excitons, n, is increased by $\Delta n = +2$. The process of exciton multiplication is considered as a sequence of real transitions between states of the unperturbed single-particle Hamiltonian having a definite number of particle–holes. One can therefore pass from one state to another following different sequences, and the amplitudes for the various chains add coherently. A statistical treatment of this interference phenomenon yields a theory of fluctuations in the excitation function and in the spectra of the emitted particles similar to the theory of the Ericson effect for the compound nucleus, if $\Gamma/D \gg 1$. It is shown that in the most common cases for medium and heavy nuclei condition equivalent to $\Gamma/D \gg 1$ obtains. For every chain, the transition amplitude can be written as a product of as many Breit–Wigner factors as the number of steps. For an (n,p) reaction with an $A \approx 100$ nucleus, an order-of-magnitude estimate of the fluctuation at the maximum of the p spectrum (~6 MeV) is 250 keV. An estimate of the fluctuation amplitude gives roughly 10 to 15% of the average differential cross section around the maximum of the spectrum for (n,p) reactions. (RWR)

9712 SIMPLE EXCITATIONS OF DOUBLY CLOSED SHELL NUCLEI. Trilling, R. East Lansing, MI; Michigan State Univ. (1972). 270p. University Microfilms Order No. 73-12,840.

Thesis (Ph. D.)

The monopole term of the multipole expansion of the interaction was replaced by a one-parameter isospin-dependent spherical potential. The parameter was evaluated from the symmetry energy between ^{49}Ca and ^{49}Sc. Two different interactions, the Kallio–Kolltveit and the Sussex, were used in two different approximations, the TDA and the RPA. The results obtained with the two different interactions were quite similar and, aside from the lowest 3^- state, the results obtained from the TDA and the RPA were almost identical. By using the monopole shift the results for ^{16}O were greatly improved. The T = 0, 1 separation energies increased along with their binding energies, to where they were in close agreement with experiment. The isospin mixing of the new vectors was such that most of the calculated B(E1)'s were in good agreement with experiment. The transition data for ^{40}Ca included only the 3^-, 5^- T = 0 levels. The monopole shift gave a net improvement of the position of the levels arising from the three lowest multiplets. The giant dipole state was, however, about 1 MeV too low when the shift is used. In ^{48}Ca and ^{88}Sr only the $T_<$ states were calculated. The monopole shift led to a definite improvement in the level positions of both nuclei for both the negative-parity and the positive-parity states. In all nuclei the RPA overband the lowest 3^- state; a reduction of the interaction strength to 65%, in order to simulate screening, for all the nuclei led to a fair agreement between experiment and theory. The calculations for ^{88}Sr predicted a strong low-lying 5^- state which up to now has not been seen. (RWR)

9713 RENORMALIZED BRUECKNER CALCULATIONS FOR CLOSED SHELL NUCLEI. Rao, S. Y. College Park, MD; Univ. of Maryland (1972). 119p. University Microfilms Order No. 73-9713.

Thesis (Ph. D.).

Brandow's mass operator variational principle is derived in a form suitable for application in calculations of finite nuclei. Only skeletons that are responsible for two-body correlations through the G matrix are retained. In the evaluation of G matrix elements in accordance with nuclear matter theory, only pure kinetic energies are used for intermediate states. The variational principle is then used to study the ground states of the closed-shell nuclei ^{16}O and ^{40}Ca by using a simple oscillator configuration model wave function, with the oscillator constant as the variational parameter. Reasonable agreement with experimental results is obtained for the radii and single-particle energies. But the nuclei as a whole are underbound to about the same extent as the best nuclear matter calculation with only two-body correlations present. The results are compared with other results in recent literature. (Diss. Abstr. Int., B)

9714 PHOTONUCLEAR REACTIONS OF LIGHT NUCLEI. Bhatt, S. C. Troy, NY; Rensselaer Polytechnic Inst. (1973). 131p. University Microfilms Order No. 73-7383.

Thesis (Ph. D.).

A detailed discussion of higher multipole contribution to the nuclear photoeffect in the light nuclei is presented. One begins with a derivation of different suitable moments of photocross sections for E2 and M1 transitions using the sum rule technique. The procedure is based on a series of articles by Levinger. For M1 operator the exchange part is introduced. The M1 contribution is calculated from ordinary part and exchange part of M1 operator. For the ordinary part of the M1 operator one obtains σ_{-1}^{M1}, the theoretical value is independent of the shape of the ground state wave function of the nucleus considered. By introducing the isospin notations in the formalism for the photo-cross section, one can use the isospin projection operator technique to obtain partial cross sections. The form of these isospin projected photo-cross sections permits one to consider particular types of two-body reactions in three and four nucleon systems. One considers the differential cross sections, and uses the angular distribution experiments to extract σ_{-1}^{M1} and $\sigma_{\frac{5}{2}}^{E2}$ photo-cross sections. A numerical integration procedure is used for the computation of these cross sections from experiments. The theoretical results give the correct order of magnitude for these cross sections and agree with them reasonably well. Finally, after making an extensive search to collect angular distribution experimental data, it is observed that the accuracy of experiments in the low energy region is not good and better experimental data is needed. (Diss. Abstr. Int., B)

9715 FINITE-RANGE DWBA CALCULATION FOR THREE-NUCLEON TRANSFER REACTIONS. Suck, S. H. Austin, TX; Univ. of Texas (1972). 147p. University Microfilms Order No. 73-7652.

Thesis (Ph. D.).

Most distorted wave direct reaction calculations rely on a zero-

range approximation. The neglect of finite-range effects is particularly unrealistic in direct reactions which involve large linear momentum transfer. The importance of the finite-range assumption is discussed in connection with direct multinucleon transfer reactions. With the aim of obtaining results superior to the zero-range approximation, the exact finite-range distorted wave Born approximation theory developed by Austern, Drisko, Halbert and Satchler is employed specifically for the (p,α) reaction. For such a three-nucleon transfer reaction two different models—phenomenological and semi-microscopic approaches for the computation of a three-nucleon form factor are presented. Finally, "zero-range" are compared with "finite-range" predictions, and the consequences of finite-range effects are discussed based on these two models. In general, effects of finite-range are seen greater at larger than smaller angles in angular distributions. It is also noticed that the semi-microscopic model predicts better agreement with the experimental angular distributions than the phenomenological or macroscopic model. (Diss. Abstr. Int., B)

9716 INTERNAL CONVERSION. pp 179-194 of Low Energy Electron Spectrometry. Sevier, K. D. New York; John Wiley and Sons, Inc. (1972).

The discussion of internal conversion emphasizes ways in which atomic properties influence internal conversion. The definition and calculation of internal conversion coefficients, conversion line form characteristics and analysis, applications of conversion electron spectrum analysis in atomic physics research, and the effects of changes in electron density near the nucleus are treated. (JFP)

9717 CONSEQUENCES AND APPLICATIONS OF ATOMIC RECOIL AFTER ALPHA-DECAY. pp 195-219 of Low Energy Electron Spectrometry. Sevier, K. D. New York; John Wiley and Sons, Inc. (1972).

Atomic recoil into solid media, alpha-decay atomic recoil effects on internal conversion lines, charge states of recoil atoms following alpha decay, complex structure of internal conversion lines due to atomic ionization, and the effect of high ionization states on low energy nuclear transitions are considered. (JFP)

9718 INVESTIGATION OF THE ACCURACY OF THE UNITARY POLE APPROXIMATION. Srivastava, M. K.; Sirohi, A. P. S. (Univ. of Roorkee, India). Nucl. Phys.; A207: No. 3, 527-537(1973).

The accuracy of the unitary pole approximation is systematically investigated by using a series of potentials with varying strengths of repulsion. Square-well potentials are taken, and the height and the range of the repulsive part are varied. The two-body binding energy is kept fixed. It is found that the UPA is best in the case of potentials which contain some repulsion the strength of which depends on the overall nature of the interaction. (7 figures, 2 tables) (auth)

9719 NUCLEAR STRUCTURE CALCULATIONS WITH DENSITY-DEPENDENT EFFECTIVE INTERACTIONS. Sharp, R. W.; Zamick, L. (Rutgers—The State Univ., New Brunswick, NJ). Nucl. Phys.; A208: No. 1, 130-156(1973).

An investigation of density-dependent interactions, such as those of Vautherin and Brink, and Moszhowski and Ehlers, is carried out. The interactions are constrained to give the correct binding energies and mean square radii of closed-shell nuclei such as ^{16}O and ^{40}Ca. Such quantities as the single-particle energies, the effective charges for E0 and E2 transitions, the mean energies of electromagnetic collective states, and the low-lying states consisting of either two particles, two holes, or a particle—hole relative to a given closed shell are then considered. Harmonic oscillator wave functions are used, but radial self-consistency is satisfied. The prescription for handling density-dependent or three-body interactions to obtain bulk properties or to do shell-model calculations is given. The rearrangement prescription for the interaction of two particles beyond a closed shell is the same as it is for the interaction of a particle and hole of the same closed shell. It is found that the J = 0 breathing mode state and the E0 effective charge are most affected by the density dependence. But this can be simulated by merely adding a monopole—monopole term to a density-independent interaction. The spin dependence of the interactions is also considered. In this respect the Vautherin—Brink interaction (II) has some desirable consequences for particle—hole calculations, i.e., the J = 0, T = 1 "Coulomb mixing state" is very high in energy. However, two identical particles in a J = 0 state have a repulsive interaction energy. This is precisely the opposite of the well-known pairing property of nuclei. Unfortunately, if one attempts to modify the spin dependence to improve the particle—particle situation, one makes the particle—hole situation worse. Evidently, additional components are required if a universal interaction is to be obtained. (6 figures, 12 tables) (auth)

9720 SPURIOUS 1^+ STATE IN DEFORMED NUCLEI. Gabrakov, S. I.; Kuliev, A. A. (Inst. of Physics, Baku). Compt. Rend. Acad. Bulg. Sci.; 26: No. 1, 39-41(1973).

The separation out of a spurious 1^+ (K = 1) state in even—even deformed nuclei is considered. (JFP)

9721 NUCLEAR-MATTER CALCULATION WITH A RANK-ONE SEPARABLE POTENTIAL. Alessandrini, J. L.; de Vega, H. J.; Schaposnik, F. A. (National Univ., La Plata). Lett. Nuovo Cim.; 7: No. 3, 98-100(19 May 1973).

A rank-one separable potential is used to calculate the binding energy per particle in infinite nuclear matter. The results are compared with values obtained with other potentials. It is concluded that the potential reproduces fairly well nuclear-matter properties. (LBS)

9722 RPA EQUATIONS FOR 2-PARTICLE—1-HOLE STATES. Schuck, P. (Massachusetts Inst. of Tech., Cambridge); Villars, F.; Ring, P. Nucl. Phys.; A208: No. 2, 302-308(1973).

Within the Dyson equation approach to higher correlation functions RPA-like equations are derived for the 2-particle—1-hole problem. The equations can be entirely expressed by the RPA sub-solutions of the particle-hole and particle-particle problem. In this way the equations are very well suited for weak or intermediate coupling situations. (auth)

9723 SET OF LIPPMANN—SCHWINGER EQUATIONS. I. For a Three-Body Scattering Theory. Takeuchi, K. (Univ. of Manchester, Eng.). Nucl. Phys.; A208: No. 1, 1-20(1973).

A theory is developed to deal with three-body scattering problems in a model space without making use of separable two-body interaction potentials. To remove the homogeneous solutions of the Lippmann—Schwinger (LS) integral kernel, constraint conditions are imposed on the solution of the LS equation, and a set of LS equations results. Study of the basic set of LS equations is done in relation to the Faddeev equations, Weinberg integral kernel, and Kazaks—Greider wave function. A new calculable single integral equation is obtained. A set of LS equations for distorted-wave treatment is also derived. (1 figure) (auth)

9724 SET OF LIPPMANN—SCHWINGER EQUATIONS. II. For Three-Body Treatments of Deuteron-Induced Reactions. Takeuchi, K. (Univ. of Manchester, Eng.). Nucl. Phys.; A208: No. 1, 21-45(1973).

The basic set of Lippmann—Schwinger (LS) equations which yields a solution uniquely is applied to the problem of deuteron-induced reactions. The usual coupled-channel equations, the lowest-order iteration solution of which gives the DWBA results, are derived; and the relevant OM potentials are studied. It is shown that, although the kernels of the LS equations are disconnected, they are calculable when the model space is restricted to those basis functions that possess finite energies and a finite number of partial waves in three-body disintegration channels. In fact, it is shown that the projected LS kernel is completely continuous in a subspace of continuous functions. The theory is applied to the (d,np) reactions including the channel nonorthogonality effects. It is also applied to the study of the effects of deuteron break-up states on the (d,p) reactions, especially of the Johnson—Soper treatment, which is improved by relaxing a part of their adiabatic approximation and by taking into account the channel nonorthogonality effects. (1 figure) (auth)

9725 SET OF LIPPMANN—SCHWINGER EQUATIONS. III. Complete Continuity of the Projected Kernel. Takeuchi, K. (Univ. of Manchester, Eng.). Nucl. Phys.; A208: No. 1, 46-54(1973).

The disconnected Lippmann—Schwinger kernel for a three-body system is shown to be completely continuous on the real energy axis when it is projected and operated on a subspace of continuous functions composed of a finite number of partial waves. (auth)

9726 NUCLEAR PHOTODISINTEGRATION WITHOUT EFFECTIVE CHARGES. Ueberall, H. (Naval Research Lab., Washington, DC); Nagel, A. Z. Phys.; 258: No. 4, 345-350(1973).

It is explicitly shown that the Thomas—Reiche—Kuhn electric dipole sum rule, for the case of nuclear photodisintegration, separates into a contribution due to dipole absorption by the nucleus as a whole and a contribution representing excitation of the internal degrees of freedom (Bethe—Levinger sum rule). The concept of the "effective charge," often employed in this connection, is not utilized in this derivation, and is seen to be essential. (auth)

9727 CORE POLARIZATION CORRECTIONS TO MAGNETIC DIPOLE MOMENTS AND TRANSITIONS. Vanden Berghe, G.; Heyde, H.; Waroquier, M. (Univ., Ghent). Z. Phys.; 259: No. 1, 37-44(1973).

Core polarization corrections to ground-state magnetic dipole

moments are calculated in first-order perturbation theory, with the use of Sussex matrix elements. These corrections are introduced in the particle–(hole-) core coupling model. It is shown that the need for effective g_s factors in the calculation of magnetic moments can be explained largely in terms of one-particle–one-hole polarization effects of the core. The influence of these effects on the reduced M1 transition probabilities for l-forbidden transitions is also considered. (1 figure, 2 tables) (auth)

9728 CORRELATION BETWEEN FISSION AND REDUCED NEUTRON WIDTHS OF FISSIONABLE NUCLEI RESONANCE LEVELS. Szentirmay, K.; Ianeva, N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Compt. Rend. Acad. Bulg. Sci.; 26: No. 1, 43-46(1973).

The dependence of the positive correlation between fission and reduced neutron widths on the loss of the resonances is estimated. (JFP)

9729 GENERAL METHOD OF MICROSCOPIC NUCLEAR MODELS. Nadzhakov, E.; Mikhailov, I. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 876-880(Apr 1972). (In Russian).

In view of the problems encountered in the explanation of fundamental nucleon–nucleon (NN) interactions, several microscopic or phenomenological approaches were developed on the basis of special models of simplifying assumptions. It was assumed that the Hamilton, H, of the nucleus designated as the "real" one is given; it includes one-particle and two-particle terms which describe, for example, the creation and annihilation of Hartree–Fock–Bogolyubov particles or quasi particles. It is further assumed that a second, "model" Hamiltonian, h, is also given. The derived microscopic approach is the reverse of the conventional method, in which the terms in the Hamiltonian are neglected in order to derive the "model" Hamiltonian h. In the new approach it is determined at the start what type of effects must be isolated out of H by determining the h, using transition operators and parameters. This leads to a description of the lower layers of the nucleus. (TTT)

9730 COUPLING SCHEMES IN NUCLEI. Talmi, I. (Weizmann Inst. of Science, Rehovot, Israel). Riv. Nuovo Cim.; 3: No. 1, 85-102(1973).

A general introduction to coupling schemes is given first. Low-lying nuclear states exhibit many simple and striking regularities, and these simple results should be derived from a simple description: the search for such a description is considered in this article. The simple regular features observed in nuclei are described, and the possible theoretical interpretation of these features is discussed. The simple structure of wave functions known to explain the data in certain nuclei is briefly considered. The seniority scheme and some generalizations are discussed and evaluated. Then the features of the nuclear interaction which give rise to rotational spectra and the way in which the transition from spherical to deformed nuclei occurs are examined. Although a definite prescription is not put forth, it seems clear that it is the p–n interaction that is responsible for the transition and that the transition involves strong deviations from the seniority scheme. In conclusion, it is stated that we should accept the fact that nuclei are made of both protons and neutrons and that in nuclei, contrary to the views presented in some theoretical papers, it is the interaction between these two kinds of nucleons that leads to rotational spectra. (16 figures) (RWR)

9731 COLLECTIVE SINGLE-PARTICLE STATES OF DEFORMED ODD NUCLEI WITH SMALL NONAXIALITY. Salakhitdinov, A. N.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 11, 28-31(1972). (In Russian).

A model for the odd nucleus, as proposed by other workers, consists of an even–even core and a single outer nucleon. This paper is an extension of this concept, and suggests its applicability to a study of high-lying excited levels of odd nuclei with small nonaxiality for which the spin of the ground state is $\frac{7}{2}$, allowing for the deformability of the nuclear shape during excitation. Theoretical and experimental values for spin and energy of the nuclei ^{167}Er, ^{177}Lu, and ^{249}Bk are tabulated. (2 figures, 1 table) (KSW)

9732 NUCLEAR CAPTURE OF Σ^- HYPERONS. Goel, S. P. (Univ., Kurukshetra, India); Prakash, Y. Nucl. Phys.; B56: No. 2, 617-634(1973).

The capture at rest of Σ^- hyperons in emulsion nuclei is studied through Monte-Carlo simulation. The Λ^0 trapping probability following Σ^- capture is estimated and compared with the corresponding probability following K^- capture. The difference in the two probabilities is explained in terms of dissimilar energy distributions of the Λ^0 hyperons produced from the captures of Σ^- hyperons and K^- mesons. Information obtained on the features of the Σ^- capture star and on the characteristics of the hyperfragments produced from Σ^- captures is presented. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

9733 PHYSICS OF IONIZED GASES, 1972. Proceedings of Invited Lectures Given at the VI Yugoslav Symposium and Summer School, Miljevac by Split, Yugoslavia, July 16–21, 1972. Kurepa, M. V. (ed.). Belgrade; Institute of Physics (1972). 818p. (CONF-720729–).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972).

Twenty-eight papers are presented under the following section headings: atomic collision processes, particle interaction with solids, and phenomena in ionized gases. Separate abstracts were prepared for fourteen of the papers. (DLC)

For abstracts of individual papers see: 8585, 8762–8764, 8793, 9198, 9246–9250, 9764, 9773, and 9868.

9734 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 4, 1973. Bibliography, author index, subject index, appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 66p.

This listing contains 294 references. (MOW)

9735 PLASMA PHYSICS INDEX. Volume 8, No. 4, 1973. Bibliography, author index, subject index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 165p.

This listing contains 429 references. (MOW)

Confinement and Heating

Refer also to abstract 9808.

9736 (AD–755445) TURBULENT RESISTIVITY, DIFFUSION, AND HEATING. Fried, B. D.; Kennel, C. F.; MacKenzie, K.; Coroniti, F. V.; Kindel, J. M. (California Univ., Los Angeles. Plasma Physics Group). Jun 1971. Contract N00014-69-A-0200-4023. 11p. (R–92). NTIS.

Current flow with density $j > nec$ (s) $c_s \equiv \sqrt{T_e/m_i}$ = ion acoustic velocity) should encounter resistance due to ion acoustic turbulence when $T_e \gg T_i$. This has been observed in experiments with a streaming cesium plasma (B = 0), in which electron current, potential rise due to turbulent resistivity, spectrum of unstable ion acoustic waves, and associated electron heating were all measured directly. Kinetic theory calculations for an expanding, unstable plasma, give results in agreement with experiment. (auth)

9737 (CONF-720705-8) ELECTRON HEATING BY MICROWAVES. Eldridge, O. (Tennessee Univ., Knoxville; Oak Ridge National Lab., Tenn.). 1972. 10p. Dep. NTIS $3.00.

From 1st topical conference on RF plasma heating; Lubbock, Texas, USA (6 Jul 1972).

The microwave heating of electron plasmas is examined critically. The primary emphasis is on theory with some discussion of experimental results. The point of view which is presented most thoroughly is the process of resonant diffusion. New results are given for the heating of relativistic electrons. (auth)

9738 (IPP-IV–49) INVESTIGATION OF RELAXATION EFFECTS BEHIND REFLECTED SHOCK FRONTS IN SHOCK-HEATED, PARTIALLY IONIZED ARGON PLASMAS. Zimmermann, W.; Muntenbruch, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Dec 1972. 181p. (In German). Dep. NTIS (U. S. Sales Only) $11.25.

The ionization relaxation behind reflected shock fronts generated by interaction of fast argon plasma flows with strong magnetic fields was studied theoretically and experimentally. A model for the shock profiles was formulated, the shock being assumed to be one-dimensional and stationary. Relaxation lengths and times as well as the electron and mass densities in the reflected shock wave were calculated numerically for various values of the frozen shock Mach number and for the two cases equilibrium ionization and perfect gas without ionization ahead of the reflected shock. Furthermore, radiation cooling effects were discussed. Measurements of the mass and electron density profiles were made by means of two-wavelength Mach–Zehnder interferometry. Spectroscopic measurements resulted in electron-density profiles in the neighboring regions. The measurements show satisfactory agreement with theory after the shock has become quasistationary at large distances upstream from the electrode region in the interaction chamber. (auth)

9739 (IPP-IV–50) OPTIMIZED LASER PULSES FOR PELLET HEATING AT REFUELLING STELLARATORS. Hora, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jan 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

Refueling of stellarators with solid pellets of deuterium (or tritium mixtures) has the advantage of an undisturbed motion of the solid material at penetration of the hot magnetoactive plasma. Only ablation processes can disturb the motion by generating a "comet tail" of plasma. Time constants for the motion of these comet tails are derived. The generation of plasma at a desired point in the stellarator by interaction with a laser pulse is discussed extensively on the basis of present experiments and their consistent interpretation. The applicability of the self-similarity model is proved and from this, calculated what laser pulses of optimal duration τ^* for numbers N_0 of pellet ions and laser pulses E_0 are necessary to generate desired ion energies ϵ_i, taking into account the transparency of the plasma after passing the cutoff density. Cases for neodymium glass and CO_2 lasers indicate the necessity of short high-energy pulses to reach ϵ_i in the fusion region. (auth)

9740 (IPPJ-140) GENERATION OF ENERGETIC ELECTRONS BY ELECTRON CYCLOTRON HEATING IN A MAGNETIC MIRROR FIELD. Ikegami, H.; Aihara, S.; Hosokawa, M.; Aikawa, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Sep 1972 39p. NTIS (U. S. Sales Only).

Electron cyclotron heating that generates hot-electron plasma in a magnetic mirror trap is studied experimentally. Evolution of energy distribution functions for the high energy electron is observed in each successive 1 msec during a 200 msec of heating period from the initial stage at the microwave power input until the stationary, final state. According to the proposed statistical model for the cyclotron heating, heating rates are estimated to be 10 Mev/sec typically, under three characteristic cases of the mirror field configuration with the microwave power as a parameter. Some problems associated with the stochastic cyclotron heating are discussed. (auth)

9741 (JAERI-M-5035) EFFECT OF THE DYNAMIC LIMITER ON PLASMA DIFFUSION. Matsuda, S. (Japan Atomic Energy Research Inst., Tokyo). Nov 1972. 14p. (In Japanese). NTIS (U. S. Sales Only).

The effect of a dynamic limiter on the plasma diffusion in JFT-2 was studied, and time–space variation in the density profile was obtained numerically with a simple model. The plasma is considered to diffuse, satisfying a pressure balance equation constant in time and space. The results should be useful in determining diffusion coefficients from experimental data. (auth)

9742 (MATT-Trans-110) ELECTRON RUNAWAY REGIME OF TOKAMAK T-6 DISCHARGES. Vlasenkov, V. S.; Leonov, V. M.; Merezhin, V. G.; Mukhovatov, V. S. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii). Apr 1973. Translation of IAE-2205. 26p. Dep. NTIS $3.50.

Experimental results of Tokamak T-6 discharges are presented in which the perpendicular plasma energy suddenly increases at the occurrence of a specific instability. It is shown that in these discharge regimes the plasma current is carried by a relatively small group of electrons with energies 10 to 500 keV, while the main plasma with $n_e \approx 3 \times 10^{12}$ cm^{-3} has a low temperature (T_e, $T_i \sim 10$ eV) and carries practically no current. Preionization of the gas or the introduction of a relatively small (~2 to 3%) local inhomogeneity in the logitudinal magnetic field converts these runaway discharges into discharges resembling those usually found in tokamaks. (auth)

9743 (ORNL-TM-4083) EFFECT OF FUEL INJECTION ON A CYCLIC β-LIMITED RADIATION DOMINATED FUSION REACTOR. Etzweiler, J. F.; Clarke, J. F.; Fowler, R. H. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 36p. Dep. NTIS $4.00.

A limiting case of cyclic operation is considered by assuming that the present neoclassical theory will describe particle diffusion and thermal conductivity in a plasma confined by a tokamak device of large size. Radiation would be the dominant energy loss from the plasma. The post-ignition operation of a reactor with particle and energy confinement times long compared to fuel-burning time is studied. It is shown that, by introducing more fuel at or after the T_i and β peaks, it is possible to extend the burn time and operate near a limit on maximum β and/or at a nearly constant power production density. The dynamics of a thermally unstable reactor are calculated. The attainable range of operating parameters for such a reactor are explored using a model for introducing fuel by the injection either of an energetic neutral beam or of cold fuel liquid or pellets. (MOW)

9744 X-RAY AND ELECTRON SPECTRA FROM THE DOUBLE INVERSE PINCH DEVICE. Baum, P. J.; Bratenahl, A.; White, R. S. (Institute of Geophysics and Planetary Physics, University of California, Riverside, California 92502). Phys. Fluids 16: No. 2, 226-230 (Feb 1973).

X-ray measurements are reported for the double inverse pinch device (Mark I) which develops an x-type neutral point through argon plasma flow. An X-ray pulse ($E > 3$ keV) is observed at a critical phase of field line reconnection. Differential absorber measurements with two proportional counters indicate an x-ray energy spectrum of the form $(dN/dE)E = aE^{-S}$, where S is 3.0 ± 0.2 and a is $(1.4 \pm 0.7) \times 10^6$ $(keV)^{3.0}$. E is the energy expressed in keV. The proportional counters also operated in the Ross filter (K-edge) mode. The x rays appear to be produced by thick target bremmstrahlung of the electrons on the copper anode in the immediate area of the x-type neutral point. An electron energy spectrum of the form $(dN/dE)E = bE^{-\gamma}$, where γ is 4.0 ± 0.2 and b is $(6.8 \pm 3.4) \times 10^4$ $(keV)^{4.0}$ is deduced from the x-ray spectrum. The x-ray signal starts less than 0.2 μsec after the resitivity minimum and continues for less than 0.25 μsec. The results suggest that runaway electrons are produced then later braked probably by the same wave-particle interactions that have been considered responsible for the current disruption at the neutral point. (auth)

9745 PLASMA CURRENT MULTIPOLE WITH A FREE BOUNDARY. Chu, M. S.; Dobrott, D. (Gulf General Atomic Company, San Diego, California 92112). Phys. Fluids 16: No. 2, 294-296 (Feb 1973).

A straight plasma current quadrupole equilibrium, a doublet, with a free boundary and outer conducting walls is examined by means of the static magnetohydrodynamic equations. Analytic expressions for the flux surfaces are obtained for the plasma and the vacuum regions when the axial current density is uniform in the plasma cross section. An internal figure-eight separatrix is obtained when position of the plasma-vacuum interface and the outer conducting wall is appropriately chosen. (auth)

9746 ANOMALOUS PLASMA HEATING INDUCED BY A VERY STRONG HIGH-FREQUENCY ELECTRIC FIELD. DeGroot, J. S. (Department of Applied Science, University of California, Davis); Katz, J. I. Phys. Fluids 16: No. 3, 401-407 (Mar 1973).

Simulation calculations and theory which show that a very strong electric field with a frequency near the plasma frequency parametrically excites electrostatic turbulence are presented. The plasma is strongly heated with the electrons receiving most of the energy. A simple electron trapping theory accounts for the saturation electric field. After the plasma becomes turbulent, the real part of the frequency of the ion mode is drastically changed from the linear value. (auth)

9747 MEASUREMENT OF DEBYE LENGTH IN LASER-PRODUCED PLASMA. Ehler, Wayne (Ames Research Center, National Aeronautics and Space Administration, Moffett Field, California 94035). Phys. Fluids 16: No. 2, 339-340 (Feb 1973).

A technique for measuring the Debye length of an expanded laser produced plasma was devised. With an independent measurement of electron density, the plasma electron temperature could then be ascertained. (auth)

9748 A FUNCTION GENERATOR FOR DYNAMIC CONTROL OF A PLASMA. Ogata, Atsushi; Watari, Tetsuo (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). Rev. Sci. Instrum. 44: No. 3, 349-350 (Mar 1973).

A function generator is constructed to generate voltage as any given function of input voltage. The generator approximates any function including a nonmontonic one by quantizing it into 11 steps. It has fast response (less than 100 nsec), good frequency characteristic (up to 10 MHz), and is easy to construct. It is to be used with a V-to-f converter in a feedback loop of rf confinement of a plasma, where the most favorable frequency is given as a nonlinear function of plasma density. (auth)

9749 PROBLEMS ASSOCIATED WITH INJECTION OF A HIGH-ENERGY NEUTRAL BEAM INTO A PLASMA. Cordey, J. G.; Houghton, M. J. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 13: No. 2, 215-220(Mar 1973).

Several problems associated with the heating of toroidal plasmas by high-energy neutral beams are discussed. The high-energy particles slow down classically on the background plasma and the distribution function of these particles is evaluated as a function of time by solving a simplified Fokker–Planck equation. The stability of this distribution is then examined both for times before and after it reaches its equilibrium configuration. It is found that in both cases the high-energy distribution is unstable unless the angle of injection is almost parallel to the field lines. Finally, the problem of the electric field which is produced by an injected neutral beam is discussed. (auth)

9750 ENERGY-BALANCE INSTABILITY OF A PLASMA IN THE THERMONUCLEAR REACTOR. Kolesnichenko, Ya. L.; Reznik, S. N. (Inst. of Nuclear Research, Kiev). Nucl. Fusion; 13: No. 2, 167-169(Mar 1973).

The energy balance stability of a thermonuclear plasma is considered in a system where energy release is assumed to be due solely to fusion reactions and energy losses are assumed to be governed by bremsstrahlung and the thermal conductivity of the plasma. It is also assumed that the temperature at the plasma boundary is much lower than the temperature at which the thermonuclear reactions are initiated and that the energy lifetime of the plasma is short compared with the charged-particle confinement time. Expressions are obtained for the thermonuclear combustion stability criterion in respect of a fluctuation for which the temperature is either rising or falling at every point of the plasma. It follows from these expressions, in particular, that if the energy release is local and the coefficient of thermal conductivity is independent of the spatial derivatives of temperature, the energy balance of a deuterium–tritium plasma will be stable only when the temperature is greater than 30 keV. (auth)

9751 IGNITION CONDITION IN TOKAMAK EXPERIMENTS AND ROLE OF NEUTRAL-INJECTION HEATING. Sweetman, D. R. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 13: No. 2, 157-165(Mar 1973).

The condition for toroidal experiments to become energetically self-sustaining is examined and a simple relationship is given between the self-ignition temperature and the plasma current. The temperature is limited at low density by synchrotron radiation and at high density by β_θ limitations. Tokamaks could, in principle, reach ignition conditions on Ohmic heating alone but will probably be limited by synchrotron radiation. A quite modest additional heating source allows ignition at higher density and the consequent examination of β_θ limitations. The power and energy requirements for neutral beam heating are examined and shown to be compatible with existing technology. (auth)

9752 THEORY OF TURBULENT PLASMA HEATING BY ANOMALOUS ABSORPTION OF MAGNETOSONIC WAVES. McBride, J. B.; Ott, E.; Wagner, C. E. (Naval Research Lab., Washington, DC). Nucl. Fusion; 13: No. 2, 151-155(Mar 1973).

Theory and computer simulation experiments have shown the potential importance of the fluid-like, modified two-stream instability as an ion heating mechanism in low-β plasmas. To take advantage of the strong ion heating which it can produce, the inducement of instability with large-amplitude waves in order to convert the energy in the wave fields into ion thermal energy is considered. Since the instability is driven by relative electron–ion drifts across a magnetic field $\vec{B}_0$, and has a frequency comparable to the lower hybrid frequency ω_{LH}, a natural choice for the driver wave is a magnetosonic wave which propagates across $\vec{B}_0$ near the Alfvén speed. As a specific example, it is demonstrated that for the parameters of the Princeton ST-Tokamak it is theoretically possible to achieve thermonuclear temperatures by anomalously absorbing these waves via the modified two-stream instability. (auth)

9753 SHOCK-HEATED WALL-CONFINED FUSION CYCLE. Gross, R. A. (Columbia Univ., New York). AT(11-1)-2233. Nucl. Fusion; 13: No. 2, 293-296(Mar 1973).

A high-β pulsed thermonuclear fusion cycle employing shock-wave heating and partial wall confinement was studied, and the principal results obtained from that analysis are given. The basic idea is analogous to a diesel engine cycle. A magnetic field piston formed by a large current in a cylindrical geometry drives a strong shock wave along a coaxial cavity. This configuration is like that used for some electromagnetic shock tubes and plasma guns. The shock creates a hot dense plasma which flows behind the wave front. At the end of the cylinder, the shock reflects from the end wall and propagates back through the plasma, heating and compressing it further, and bringing the plasma to rest relative to the cylinder. By turning on an additional strong cusp magnetic field (a magnetic dam) the plasma may be confined to the end of the tube. The main elements of the analysis of this cycle are described. (MOW)

9754 PARTICLE DIFFUSION DUE TO FLUCTUATIONS IN TOROIDAL SYSTEMS. Bickerton, R. J. (Culham Lab., Abingdon., Eng.). Nucl. Fusion; 13: No. 2, 290-292(Mar 1973).

Symmetric toroidal systems are considered in which the toroidal component of the magnetic field is much larger than the poloidal component. Recently, the theory of classical diffusion in these systems has undergone rapid development and it is now clear that, particularly at low collision frequencies, it is primarily the poloidal field component which controls the diffusion rate. It is shown that this also true for fluctuation-induced losses. Low-β systems are studied and it is assumed that there are no fluctuations in the magnetic field. (MOW)

9755 HEATING OF A PLASMA BY MULTIPHOTON INVERSE BREMSSTRAHLUNG. Seely, John F.; Harris, Edward G. (University of Tennessee, Knoxville, Tennessee 37916). Phys. Rev. A 7: No. 3, 1064-1067 (Mar 1973).

The heating of plasma electrons in a laser beam by the inverse Bremsstrahlung process is considered from a quantum-mechanical viewpoint. A kinetic equation is derived and the change in kinetic energy of the electrons is calculated. Effective collision frequencies are found for the two cases of weak field and strong field and are compared to the classical results. It is found that the Coulomb logarithm, which appears in the classical expressions for the effective collision frequency, does not appear in the strong-field expression for effective collision frequency of the present work. (auth)

9756 PARTIAL TRAPPING OF A LOW-DENSITY PLASMA BY AN RF QUASIPOTENTIAL WELL. Johnson, Curtis D. (The University of Texas at Austin, Austin, Texas 78712). J. Appl. Phys. 44: No. 4, 1581-1586 (Apr 1973).

A study is made of plasma trapping by the radio frequency (rf) quasipotential well of a cylindrical resonant cavity operating in the TM011 mode. This is done by injecting a plasma into the cavity with continuous rf excitation and observing the subsequent plasma decay. The experiment is conducted in such a way that the potential well appears only during the plasma decay. A significant delay in decay time is observed, and calculations indicate this to be due to partial trapping of the plasma by the quasipotential well. This trapping is observed experimentally at an electron density $n_e \approx 10^9$ cm^{-3} for a plasma with an electron temperature $T_e \approx 2.5$ eV. Trapping is noted by an increase in decay time for an average rf quasipotential well energy < 8 eV. For higher well energy, an anomalous loss of plasma is observed as indicated by a marked decrease in decay time. (auth)

9757 EXPLOSIVELY DRIVEN DEUTERIUM ARCS AS AN ENERGY SOURCE. Cowan, M.; Freeman, J. R. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 44: No. 4, 1595-1603 (Apr 1973).

A cylindrical arc in deuterium plasma was imploded with high explosive into its own magnetic flux to form a powerful source of pulsed energy. Joule heat produced during flux compression appeared to be radiated about as fast as it was generated by the conducting plasma, consistent with the release of about 10^6 J of radiant energy with peak power about 10^{12} W. During implosion, the magnetic field increased to about 10^2 Wb/m^2 and supported a current density of 3×10^{11} A/m^2. The plasma arc was estimated to have a density of 10^{27} m^{-3} and to reach a temperature of 2×10^5 °K. Calculations are made using a one-dimensional time-dependent hydromagnetic model which includes thermal conduction, radiant heat transfer, self-consistent magnetic fields, and temperature-dependent transport properties. The finite difference solution predicts arc currents, plasma properties, and radiation losses consistent with the experimental observations. A simplified analytical theory is derived to provide convenient scaling information. (auth)

9758 CONTINUOUS LASER-SUSTAINED PLASMAS. Franzen, Douglas L. (Institute for Basic Standards, Quantum Electronics Division, National Bureau of Standards, Boulder, Colorado 80302). J. Appl. Phys. 44: No. 4, 1727-1732 (Apr 1973).

Continuous plasmas sustained by a focused high-power CO_2 laser are described. The power required for maintaining a cw plasma following preionization has been determined for Xe, Kr, and Ar, and attempted for Ne and He. Measurements indicate the noble gases with the lowest ionization potentials have the lowest sustaining thresholds. Radiative properties of some of the plasmas were studied with calorimetric techniques. Under certain conditions, more than half of the incident laser radiation can either be scattered or absorbed by the plasma. A major loss mechanism for the plasma is shown to be radiation in the visible and ultraviolet. Spectra of low-pressure Xe plasmas indicate the presence of ultraviolet transitions with a high contrast over the continuum. (auth)

Diagnostics

Refer also to abstract 9806.

9759 (AD-751938) STUDY OF PROPERTIES OF PLASMAS PRODUCED IN MOLECULAR GASES BY MEANS OF MASS AND OPTICAL SPECTROSCOPY. Final Report, 31 August 1971-31 August 1972. Oskam, H. J. (Minnesota Univ., Minneapolis. Dept. of Electrical Engineering). Sep 1972. Contract F19628-72-C-0042. 15p. (AFCRL-72-573). NTIS.

Results obtained from studying plasmas by means of mass and optical spectroscopy are summarized. The measuring method consisted of measuring the time dependence of the density of ions and that of the intensity of spectral lines and bands emitted during the plasma decay period. The plasmas were produced in neon, nitrogen, and in helium-nitrogen, neon-nitrogen and helium-hydrogen mixtures. Production and loss mechanisms of ions were established, while the origin of the emission of light during the plasma decay period was determined. (auth)

9760 (AD-752544) SIMPLE X-RAY BANDPASS FILTERS FOR NANOSECOND RESOLUTION OF PLASMA SPECTRA. Report for March 1970-February 1972. Bernstein, M. J. (Aerospace Corp., El Segundo, Calif.). 30 Oct 1972. Contract F04701-72-C-0073. 24p. (SAMSO-TR-72-264). NTIS.

A novel type of bandpass filter for x rays has been developed for use in studies of hot transient plasmas. Suitable bandpass intervals are defined by transmission through thin K-edge filters and absorption in matched thicknesses of scintillator material. The scintillator light signals are detected by either a set of photomultipliers or an image-converter camera, operated in the streak mode. Filters of Mg, Al, Cl, and Ti cover the 1- to 5-keV photon energy range and are useful with plasmas that have temperatures of 0.2 to 2.0 keV. (auth)

9761 (AD-755373) PLASMA ENHANCEMENT AND DIAGNOSTIC POSSIBILITIES OF SELECTIVE LASER EXCITATION. Final Scientific Report, 1968-1973. Measures, R. M. (Toronto Univ. (Ontario). Inst. for Aerospace Studies). Jan 1973. 6p. (AFOSR-TR-73-0110). NTIS.

The progress made towards demonstrating the viability of the new plasma diagnostic technique referred to as "selective excitation spectroscopy" is outlined and other related topics are mentioned. The results to date are encouraging and developments in the field of tunable lasers should enable this new approach to be used in a variety of applications. (auth)

9762 (UCID-16218) STREAK CAMERA TUBE DEVELOPMENT. Kalibjian, R.; McConaghy, C. (California Univ., Livermore. Lawrence Livermore Lab.). 2 Mar 1973. 6p. Dep. NTIS $3.00.

A high-speed cathode-ray tube was modified for streak camera application by replacing the thermionic cathode with an S-1 photocathode. This is the first step in the development of a 2-picosecond resolution streak camera tube. Development of an x-ray photocathode for the streak camera tube is also reported. (auth)

9763 ELECTRON TEMPERATURE MEASUREMENTS ALONG A STAGNATION POINT STREAMLINE. Nishida, Michio; Sugimoto, Shuji (Department of Aeronautical Engineering, Kyoto University, Kyoto, Japan). Phys. Fluids 16: No. 2, 202-204 (Feb 1973).

Experimental observations of the electron temperature profile along a stagnation point streamline have been found to be in good agreement with the theory developed for the case where the interaction between an electron thermal layer and a viscous shock layer was considered. The electron temperature measurements have been carried out with the Langmuir probe technique in an argon plasma flow. (auth)

9764 ELECTRIC PROPERTIES OF DENSE PLASMAS IN HIGH-CURRENT PULSED DISCHARGE. Popovic, M. M. (Inst. of Physics, Belgrade). pp 651-666 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

A brief account is given of the experimental determination of the electric parameters of Ar and Xe plasmas produced in pulse discharges, and attempts to derive semi-empirical and empirical relations for such plasmas are presented. Some data on the electric properties are given. The ratio of electric conductivity to the traditional Spitzer value is discussed. It is concluded that a method still does not exist for a simple but correct calculation of the electric conductivity and other transport coefficients of ionized gases with a small number of particles in the Debye sphere. (49 references) (DLC)

9765 EQUILIBRIUM ELECTRON TEMPERATURE AND DENSITY IN A PURE ARGON PLASMA PRODUCED USING A SHOCK TUBE. Larcher, G.; Thenard, C.; Maillot, P. (Rouen Univ., Mont-Saint-Aignan, France). Compt. Rend., Ser. B; 276: No. 8, 295-298(19 Feb 1973). (In French).

The results obtained using spectrophotometry for the determination of the equilibrium electron temperature and density in a pure argon plasma produced in a shock tube are presented for initial wave velocities varying between Mach 10.5 and 13.5, the initial gas pressure being 1.5 torr. (FR)

9766 FILTER METHOD AND SILICON DETECTORS TO MEASURE THE TEMPERATURE OF A HOT DENSE THERMAL DEUTERIUM PLASMA FROM ITS QUANTUM BREMSSTRAHLUNG. Robouch, B. V.; Rager, J. P. (Laboratori Gas Ionizzati (Associazione Euratom-Cnen), Frascati, Rome, Italy). J. Appl. Phys. 44: No. 4, 1527-1533 (Apr 1973).

The filter method, used to measure the temperature of a hot ($T > 1$ keV deuterium plasma through its bremsstrahlung emission, is studied

taking into account two new features: (i) the bremsstrahlung emission (accounted for, up until now, by its classical approximation) is described by its quantum expression, (ii) real solid-state silicon detectors are considered, instead of ideal ones. Deductions are made concerning the best choice of the detector and the corresponding adequate filter for different temperature ranges; the limits of the temperature ranges are established considering the minimum number of points necessary to identify the shape of the spectrum curve, as well as the loss of efficiency of the detectors at high energies. An upper bound is set to the measurable temperature. Neutron radiation damages to the Si detectors, at current and foreseen levels, are considered and shown to impose no serious limitation to the practical applicability of the method. (auth)

Kinetics (General)

9767 (AD-753247) LOWERING OF THE IONIZATION POTENTIAL OF AN ATOM IN A HIGH-TEMPERATURE AND HIGH-DENSITY PLASMA. Srivastava, S. K.; Weissler, G. L. (University of Southern California, Los Angeles. Dept. of Physics). 1 Dec 1972. Contract N00014-67-A-0269-0014. 21p. (USC-VacUV-131). NTIS.

Lowering of the ionization potentials of hydrogen and carbon atoms immersed in a high-temperature and high-density thermal plasma generated in a Maecker-type wall-stabilized arc were estimated from the advance or shift of their respective series limits in the vacuum-ultraviolet region of the spectrum for different electron densities and temperatures, making use of the Inglis-Teller criterion. The question of the validity of a critical electron density is discussed. In addition, the physical significance of using the shift of the series limit in the Saha equation as the term equivalent to the lowering of the ionization potential is also considered. (auth)

9768 (AD-753404) ENHANCED LASER SCATTERING AND BREMSSTRAHLUNG EMISSION FROM NONTHERMAL THETA-PINCH PLASMAS. Stainer, H. M. (Johns Hopkins Univ., Silver Spring, Md. Applied Physics Lab). Oct 1972. Contract N00017-72-C-4401. 61p. (APL-TG-1199). NTIS.

The conditions under which enhanced scattering of far-ir laser radiation (337 μ) can be obtained from theta-pinch plasmas are studied. The enhanced scattering cross section results from large electron density fluctuations generated by nonthermal electrons in the plasma. The scattering cross section is derived from kinetic theory using rigid-rotor distributions to model the specific theta-pinch plasma, and the conditions under which it can become greatly enhanced are examined. Three types of bremsstrahlung—free-free, magnetic wave-wave, and nonmagnetic wave-wave—are discussed and the power produced by each kind computed and compared to the scattered power. For typical HCN laser power densities of the order of 10 W/cm^2, the bremsstrahlung considerably exceeds the scattered power in both the wideband (overall frequencies) and narrowband receiver cases. Additional calculations indicate that an experiment with the more powerful CO_2 laser (λ = 10.6 μ) would be more likely to succeed. (auth)

9769 (IPPJ-DT-30) SHAPING OF LASER PULSES BY THE USE OF A LASER-TRIGGERED SPARK GAP AND A POCKEL CELL. Yoshida, K; Shimamura, K.; Yamanaka, T.; Yamanaka, C.; Sasaki, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jan 1972. 15p. (In Japanese). NTIS (U. S. Sales Only).

Characteristics of a laser triggered spark gap (LTSG) were investigated and a method to generate a laser beam by the pulse transmission mode (PTM) is reported. The pressurized LTSG containing nitrogen gas was used for this experiment. Relation between self-breakdown voltage and pressure of gases (Ar and N_2) was obtained. Good characteristics were seen for the LTSG with the mixed gas of Ar and N_2. Relation between delay time of discharge and ratio of LTSG voltage and the self-breakdown voltage was also measured. Relation between the delay time and electrode spacing, and between the delay time and laser power were measured, and are shown. Rise time of the LTSG voltage is shown as a function of the electrode spacing. A system to generate the laser beam with variable pulse width was constructed. The system has a built-in modulator in a cavity. A polarized plane was rotated by a pockel cell connected to the LTSG. The laser pulses have a rise time of 1.5 ns and pulse width of 1 to 30 ns. (JA)

9770 (JAERI-M-5029) ANNUAL REPORT OF JAERI THERMONUCLEAR FUSION LABORATORY FOR PERIOD ENDING MARCH 31, 1972. (Japan Atomic Energy Research Inst., Tokyo). Oct 1972. 65p. NTIS (U. S. Sales Only).

Works carried out in the JAERI Thermonuclear Fusion Laboratory for the period of April, 1971 to March, 1972 are described. These include research on tokamaks, plasma confinement and instabilities, and diagnostics. (MOW)

9771 (KFTI-72-7) THEORETICAL AND EXPERIMENTAL STUDY OF THE ACCELERATION METHODS BY THE PLASMA. 1972. 32p. (In Russian). INIS.

The results of the theoretical and experimental study of the excitation of the regular accelerating fields during interaction of relativistic and nonrelativistic beams of charged particles with plasma were reported. The acceleration of electrons with fields of slow waves of plasma wave-guides, excited by external generators, was also studied. (tr-auth)

9772 ESTABLISHMENT OF PARTIAL LOCAL THERMAL EQUILIBRIUM IN TRANSIENT AND INHOMOGENEOUS PLASMAS. Engelhardt, W. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland). Phys. Fluids 16: No. 2, 217-220 (Feb 1973).

New formulas for relevant relaxation times and relaxation lengths for the establishment of partial local thermal equilibrium are presented taking into consideration the influence of the ground state on the population of the excited levels and on the energy distribution of the free electron gas. (auth)

9773 INFLUENCE OF ATOM-ATOM COLLISIONS ON ELECTRON DENSITY DECAY IN LASER-PRODUCED HELIUM PLASMAS. Drawin, H. W. (EURATOM-CEA, Fontenay-aux-Roses, France). pp 705-775 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

A historical review is given of the calculation of collisional-radiative volume recombination coefficients. Work done on the recombination in dense helium plasma is presented, with the theory being presented first and then their results compared with measurements on laser-produced helium plasmas. (20 figures, 4 tables, 73 references) (DLC)

9774 PLASMA TEMPERATURE MEASUREMENTS USING SELF-ABSORBED SPECTRAL LINES. A Discussion of the Methods Due to Bartels and Kruithof. De Groot, J. J.; Jack, A. G. (Philips Gloeilampenfabriken NV, Eindhoven, Netherlands). J. Quant. Spectrosc. Radiative Transfer; 13: No. 7, 615-626(Jul 1973).

The plasma temperature measuring methods due to Bartels (Z. Phys.; 127: 243(1950); 128: 546(1950)) and Kruithof, (Proc. 8th. Int. Conf. on Phenomena in Ionized Gases, p. 223. Vienna (1967)) which make use of self-absorbed spectral lines, are particular solutions of the radiative transfer equation. For conditions found in typical high-pressure gas discharges used as light sources, the radiative transfer equation was solved numerically. These results are used to investigate the influence of several of the simplifying assumptions which are necessary in order to apply the two methods. Particular attention was paid to the influence of the line profile and the plasma temperature distribution. It is shown that, for conditions found in typical high-pressure light sources, some of the simplifying assumptions can be relaxed without serious loss of accuracy. Possible extension of the methods to include resonance lines has also been considered. (auth)

9775 BOUNDARY PROBLEM OF ANISOTROPIC VLASOV PLASMA. Sakuda, Kyohei (New York University, Bronx, New York 10453); Palócz, István. Phys. Fluids 16: No. 2, 259-269 (Feb 1973).

The boundary problem at the interface between vacuum and plasma is studied. The plasma is one component and homogeneous, but anisotropic due to an external static magnetic field. The plasma is described by the linearized Vlasov equation. In order to obtain the field quantities, i. e., first-order electric and magnetic field, and the velocity distribution function, the dyadic Green's function is derived. Then, by applying the completeness relationship, the complete set of eigenvectors corresponding to the continuous as well as discrete spectra, are derived. By virtue of the superposition integral, all first-order quantities are obtained, once the expansion coefficients are determined. To obtain the expansion coefficients uniquely, the speçulum assumption and outgoing wave condition are used. The reflection coefficients of the left- and right-hand polarized waves are calculated. Because of the different dispersion relations for the two different polarized waves, the two surface impedances are different, therefore, the reflection coefficients are different. The polarizations of the reflected and the transmitted waves depend on the excitation frequency. (auth)

9776 THIN E-LAYER EQUILIBRIA. Rensink, Marvin E. (Lawrence Livermore Laboratory, University of California; Livermore, California, 94550). Phys. Fluids 16: No. 3, 443-449 (Mar 1973).

The equilibrium of an infinitely long, thin E layer under the influence of external and self-fields is studied. The canonical angular momentum and the total energy per particle are constant in this analysis. The results can be summarized as follows: (1) with complete charge neutralization, as the number of particles N increases, the E-layer radius R_e tends toward the value $R_e = (R_w R_c)^{1/2}$, where R_w and R_c are the radii of the outer and inner conducting walls, respectively, (2) the

total kinetic energy per particle initially decreases as N increases; (3) the axial temperature increases with N so as to maintain stability with respect to the tearing mode; and (4) the current per unit length saturates at a value well beyond that required for field reversal. (auth)

9777 STEADY-STATE INTERACTIONS IN PLASMA ACCELERATORS. Steinolfson, R. S. (Univ. of Colorado, Boulder). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 11: No. 6, 779-780 (Jun 1973).

An analytical study of the steady-state interactions between a gas and a force field is presented. The several different types of interactions that occur for different magnitudes of the body force and heat addition are described. The effect of maintaining an initial pressure difference across the force field is also discussed. Although the analysis is applicable for any type of body force and heat input, reference is made to plasma accelerators where the Lorentz force and Ohmic heating are the appropriate quantities. (auth)

9778 NEOCLASSICAL DIFFUSION ARISING FROM MAGNETIC-FIELD RIPPLES IN TOKAMAKS. Conner, J. W.; Hastie, R. J. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 13: No. 2, 221-225(Mar 1973).

A solution of the Fokker–Planck equation is obtained for the distribution of trapped particles in the magnetic field ripples of an imperfectly axisymmetric tokamak; the resulting particle flux and the ion heat flux arising from the toroidal drift of such particles are calculated, revising previous estimates which neglected the asymmetry of the ripple profile. (auth)

9779 ENERGY PRINCIPLE WITH SPECIFIC INDUCTANCE. Bateman, G. (New York Univ., NY). Nucl. Fusion; 13: No. 2, 227-238(Mar 1973).

The determination of stability for a scalar-pressure toroidal plasma is formulated by means of an energy variational principle in which the geometric problem of variation of the flux-surface shapes is separated from the variation of the flux profile. By means of successive minimizations, holding the surface shapes and the flux profiles fixed, the potential energy is written as a one-dimensional integral over a function of pressure, differential flux, and the specific-inductance matrix. The latter depends only on the geometry of the surfaces. Stability conditions are derived by varying the flux profile and the geometry (specific inductance). Also, a nonlinear stability condition is derived for the special case of a finite geometric distortion of the flux surfaces while holding the flux profiles fixed. Exact representations for the specific inductance are calculated for straight cylinders, axisymmetric toruses, and helically symmetric configurations, all with arbitrary cross sections. (auth)

9780 ONTOGENY OF A TOKAMAK DISCHARGE. Dimock, D. L.; Eubank, H. P.; Hinnov, E.; Johnson, L. C.; Meservey, E. B. (Princeton Univ., NJ). Nucl. Fusion; 13: No. 2, 271-280(Mar 1973).

A detailed description of the time behavior of a hydrogen discharge in the ST-Tokamak is based on measured radial electron temperature and density profiles at 12 different times, together with: measurements of the Ohmic-heating current and voltage; the temporal, spatial, and spectral distributions of hydrogen light; the ion temperatures; and impurity concentrations. Early in the discharge the electron-temperature profiles show evidence of a skin effect that develops on a time scale of several milliseconds into a peaked profile of about 2.2 keV maximum. Thereafter, the peak temperature stops growing and develops into a flat plateau, the width of which appears to be determined by the Kruskal–Shafranov limit. The average particle-confinement time scales with $\bar{T}_e^{\frac{3}{2}}$, and reaches a maximum of 13 to 14 ms. The power balance is dominated by electron loss and re-cycling, rather than ion loss or radiation. The recycling process at the aperture limiter appears to involve sufficiently energetic neutral atoms to provide a fairly flat radial source function for particles, and hence to influence directly the development of the radial distribution of power input and energy balance. (auth)

9781 EXACT MEASUREMENT OF THE CONTINUOUS EMISSION OF A NITROGEN PLASMA. Nikolaevskii, L. S.; Podmoshenskii, I. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 33: No. 3, 237-239(Sep 1972).

Translated from Opt. Spektrosk.; 33: No. 3, 440-443(Sep 1972).

The emission of a pulsed discharge in an open tube is used to measure the continuous absorption coefficients of a nitrogen plasma in the spectral region 15,000 to 22,000 cm^{-1} at two pressures 0.50 atm and 0.75 atm and two temperatures 19,000°K and 20,000°K, respectively. The data are recorded photographically, and the relative error in determining the absorption coefficients is 10%. It is shown that the experimental data differ from the theoretical by not more than 15%. (auth)

9782 BEHAVIOR OF THE CHEMICAL POTENTIAL OF A DENSE ELECTRON PLASMA IN A STRONG MAGNETIC FIELD. Glasser, M. L. (Battelle Memorial Inst., Columbus, OH). Phys. Lett.; 44A: No. 2, 93(21 May 1973).

The behavior of the chemical potential of a dense electron plasma in a strong magnetic field is studied. It is found that at $T = 0$ this potential vanishes as H^{-1}. (auth)

Kinetics (Experimental)

9783 (AD–753705) LASER SCATTERING FROM THE DENSE PLASMA FOCUS. Final Report. Eisner, M. (Houston Univ., Tex. Dept. of Physics). 15 Dec 1972. 7p. (AFOSR-TR–72-2433). NTIS.

Time resolved scattering spectra were observed from a dense plasma focus (DPF) illuminated by a pulse of laser light. Scattering was observable from 10 ns prior to arrival of the collapse on axis and for an additional 50 ns. The frequency spectrum is markedly asymmetric about the laser frequency, a feature that is inconsistent with spectral expectations based on thermal particle distributions even if particle drifts or wave excitations are included. A model is postulated that attributes the asymmetry to lateral displacement of scattering region from the axis of the focus. Analysis based on this model yields radial collapse velocity, density, and ion temperatures. Noteworthy features are the absence of radial bounce, indication of axial jetting, and the formation of an axial wake. (auth)

9784 PROPAGATION OF DENSITY PERTURBATIONS IN A COLLISIONLESS Q-MACHINE PLASMA. Michelsen, P.; Pécseli, H. L. (Danish Atomic Energy Commission, Research Establishment Risø, Roskilde, Denmark). Phys. Fluids 16: No. 2, 221-225 (Feb 1973).

The evolution of the ion velocity distribution function is calculated by means of the linearized Vlasov equation for the case where the initial perturbation consists of a step-like density discontinuity. Some characteristic features in the solution are caused by wave-particle interaction. These features are found experimentally by perturbing the plasma in a single-ended Q-machine by means of a grid immersed in the plasma column. The perturbed ion distribution function is measured with an electrostatic energy analyzer. (auth)

9785 MEASUREMENT OF STARK-BROADENED BALMER LINES EMITTED FROM A LOW-DENSITY hf DISCHARGE. Fussmann, G.; Himmel, G. (Univ., Bochum, Ger.). Z. Phys.; 259: No. 4, 347-353(1973). (In German).

The Balmer lines H_6 to H_{12} of a calibrated hf discharge ($N_e = 1.45 \times 10^{13}$ cm^{-3}) are investigated. The measurement of the line wings is extended to intensities less than 10^{-3} of the peak intensity. For higher lines the transition to the asymptotic Holtsmark wings is observed. The results are compared with quasi-static calculations and with predictions of the unified theory. In the former case the experimental profiles show a somewhat larger broadening, in the latter case a somewhat smaller broadening. The differences are most pronounced for lower series members. The large broadening found by Bengtson, Kepple, and Tannich is not confirmed. (GE)

9786 ELECTRICAL CONDUCTIVITY AND TOTAL EMISSION COEFFICIENT OF AIR PLASMA. Schreiber, P. W. (Aerospace Research Labs., Wright-Patterson AFB, OH); Hunter, A. M. II; Benedetto, K. R. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 11: No. 6, 815-821(Jun 1973).

The electrical conductivity, σ, and the total radiant power per unit volume, P_R, of air are measured for temperatures between 8,000 and 12,500°K at atmospheric pressure. The measurements are made in a wall-stabilized electric arc discharge which produces a pure, stable plasma. Axial electric field strength, E_z, and azimuthal magnetic field intensity, B_θ, are measured as functions of the discharge radius by using probe techniques. Current density, j_z, is obtained as $\bar{j} = \nabla \times \bar{B}/\mu_0$, and electrical conductivity is determined by using Ohm's law, $\sigma = j_z/E_z$. P_R is measured with a total radiation thermopile and also by using an electrical technique. Plasma temperature is determined from the absolute intensities of the 4935 Å N I and 4368 Å O I lines. (auth)

9787 RADIAL PROFILE OF LONGITUDINAL PLASMA CURRENT: TEMPORAL DEVELOPMENT. Tanaka, Y. (Nagoya Univ., Japan). Nucl. Fusion; 13: No. 2, 171-177(Mar 1973).

The radial profile of a longitudinal plasma current is experimentally investigated. When the relative drift velocity between ions and electrons becomes larger than the ion thermal velocity, a temporal development of plasma parameters, such as electrical conductivity, electron temperature, longitudinal electrical field, and radial profile of the longitudinal current is observed. The

effective collision frequency for electron heating is estimated. A set of initial and circuit conditions is obtained which assures that the final high-temperature plasma is produced without appreciable loss. It is concluded that the appearance of a restoring force towards plasma stability due to a sheared mangetic field may be a key point in attaining a final stable plasma with arbitrary plasma current. (auth)

9788 ELECTRICAL BREAKDOWN IN A COLLISION-DOMINATED PLASMA SHEATH. Mikoshiba, S.; Smy, P. R. (Department of Electrical Engineering, University of Alberta, Edmonton, Alberta, Canada). J. Appl. Phys. 44: No. 4, 1562-1570 (Apr 1973).

The field strength at a cathode is increased by the presence of a moving plasma due to the formation of a cathode sheath in which the ion mobility is reduced by the high neutral density in the cold boundary layer formed around the electrode. If further field intensification due to surface irregularities is included, the field at the cathode reaches and exceeds 3×10^7 V/cm, the field emission threshold. This field can be achieved at an applied voltage between electrodes of 40 V, which is well below the Paschen minimum. This effect was studied experimentally using the argon plasma generated in electromagnetically driven shock tube for wide ranges of plasma density (10^9–10^{16}cm^{-3}), degree of ionization, and initial pressure (0.1–10 Torr). The results should form the basis for prediction of the reignition characteristics in the all important period immediately (1–10 μsec) after the cessation of an arc. (auth)

Kinetics (Theoretical)

Refer also to abstract 8059.

9789 (AD-752498) EQUILIBRIUM STATE OF FINITE LENGTH PLASMA PUFFS: A GREEN'S FUNCTION APPROACH TO THE RESULTANT GENERALIZED AXISYMMETRIC POTENTIAL EQUATION. Stainer, H. M. (Johns Hopkins Univ., Silver Spring, MD. Applied Physics Lab.). Aug 1972. Contract N00017-72-C-4401. 27p. (APL-TG-1200). NTIS.

The equilibrium state of plasma puffs produced by a theta-pinch gun firing into an axial magnetic field is studied theoretically. The plasma puffs are of finite length, with radially and axially dependent density gradients. This model, which is physically more realistic than an infinitely long puff, leads to a nonlinear partial differential equation for the density that is related to the generalized axisymmetric potential (GASP) type of equation. A Green's function method is described for converting the partial differential density equation into an iterative integral equation that appears more amenable to computer treatment. The iterated density thus becomes functional of the trial density, which is the kernel of the integral equation. (auth)

9790 (COO-2059-19) STATISTICAL MECHANICS OF NEGATIVE TEMPERATURE STATES. Montgomery, D.; Joyce, G. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Mar 1973. Contract AT(11-1)-2059. 37p. Dep. NTIS $4.00.

The dynamics of two-dimensional interacting "line" vortices is identical to that of the two-dimensional electrostatic guiding-center plasma. Both are Hamiltonian systems and are therefore susceptible to statistical mechanical treatments. The predictions of the microcanonical ensemble are explored for this system. Interest focuses primarily on the regime of total positive interaction energy, which should be above the Onsager "negative temperature" threshold. Calculations of the probability distribution for a component by means of the central limit theorem are carried out in the manner of Khinchin. The probability distribution of a component reduces to the usual Gibbs distribution in the regime of positive temperatures, and is still explicitly calculable for negative temperatures. The negative temperature states are neither quiescent nor spatially uniform. Expressions for the temperature are explicitly provided in terms of the total particle energy and particle number. An extensive "thermodynamic limit" appears not to exist for the system. A BBGKY hierarchy can be derived for both temperature regimes. A Vlasov approximation on the first pair of BBGKY equations leads to the differential equation (two dimensions) $\nabla^2\Psi + \sinh\Psi = 0$. The charge (vortex) density has an expectation value proportional to $\nabla^2\Psi$. Numerical simulations involving solutions of the equations of motion of 4008 particles are presented. (auth)

9791 (COO-2081-11) ELECTRON SCATTERING BY ENHANCED FLUCTUATION IN QUIESCENT 2XII DECAY. Aamodt, R. E.; Baldwin, D. E. (Colorado Univ., Boulder; California Univ., Livermore. Lawrence Livermore Lab.). 22 Jan 1973. Contract AT(11-1)-2081. 5p. (UCID-16202). Dep. NTIS $3.00.

It is shown that under the conditions of quiescent 2XII decay electron–electron collisions dominate the electron scattering due to the Rosenbluth–Post instability so that a Maxwellian electron distribution function is maintained. (auth)

9792 (EUR-CEA-FC-683) DIGITAL SIMULATION OF THE INTRODUCTION OF COLD OR ENERGETIC NEUTRAL PARTICLES INTO A HOT PLASMA. Boujot, J. P.; Mercier, C.; Morera, J. P.; Soubbaramayer. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1973. 51p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

A simplified digital code for studying the evolution of a plasma in a tokamak device was presented earlier. This code is completed by analyzing the effects due to cold or energetic neutral particles. Two versions are presented: a complete version in which the Maxwellian velocity distribution at each point is taken into consideration; a simplified version in which only mean velocities are considered. The new code is coupled with the antecedent code in order to evaluate the matter and energy sources and sinks necessary to account for the evolution of the plasma. The code also gives the velocity spectrum of the neutral particles leaving the plasma. (FR)

9793 (EUR-CEA-FC-685) STUDY OF THE EVOLUTION OF A PLASMA NEAR A NEUTRAL POINT IN A MAGNETIC FIELD. Pantuso Sudano, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1973. 26p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

Thesis.

Exact analytical solutions near a neutral point for the Landau–Lifshitz magnetohydrodynamic equations were sought. Ordinary differential equations were solved for particular cases, and the results obtained were compared with those of other workers. The effects of a magnetic field, the electric conductivity, the homogeneous viscosity, and the choice of different initial conditions were studied. (FR)

9794 (FRNC-TH-329) MATHEMATICAL MODELS FOR NONCOLLISIONAL PLASMAS. Bertrand, P. (Nancy Univ. (France)). 1972. 157p. (In French). NTIS (U.S. Sales Only).

Thesis.

The complexity of the Vlasov equation for noncollisional plasmas led to the use of an analytical–digital philosophy in which the phase and velocity spaces were considered to be discrete. The water-bag model was employed, this model having characteristics intermediate between those of Lagrangian and Eulerian plasma models. The basic hypothesis of the model consists of considering the distribution function to have constant values in certain regions of phase space. The hypothesis at $t_0 = 0$ remains valid as a result of the Vlasov equation. The simple water-bag model (single contour) is rigorous for initial conditions of the f = A type. In addition it provides a very good approximation for long-wavelength phenomena under adiabatic conditions, i.e., conditions under which the Pn^{-3} invariant is not perturbed. The model enables the existence of nonlinear effects (occurrence of harmonics, frequency drift) and effects due to the existence of inhomogeneities (appearance of narrow-frequency bands) to be established. The cases of 2 and 3 contours enable instability phenomena with a very restricted number of parameters to be explained, i.e., double-beam type instabilities (marginal stability, Bloch–Floquet theorem). (FR)

9795 (IPP-2/208) KINETIC MODEL FOR THE NEUTRAL GAS BETWEEN PLASMA AND WALL. Rehker, S.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jan 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

Starting from the Boltzmann equation for the neutral gas in a plasma, an integral equation for the density of the neutral gas is derived. Inelastic collisions are considered only as charge exchange and ionization. The integral equation is solved numerically. It is shown that the reflection mechanism of neutral particles from the wall modifies the density profile. The distribution function of the charge exchange neutrals deviates from a Maxwellian, and for fast particles ($v > v_{th}$) one obtains $f_0 \sim v^{-1} \exp[-(v^2/v_i)]$. The total particle and energy fluxes on the wall are also calculated. (auth)

9796 APPLICATIONS OF AN IMPROVED FORMALISM FOR THE ANALYSIS OF TRANSPORT PHENOMENA IN GASEOUS MIXTURES AND PLASMAS. McCandless, R. J.; Rush, D. J.; Wilkins, D. R.; Katra, J. A. (General Electric Co., Cincinnati). pp 292-299 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Review of a theoretical formalism for the analysis of transport phenomena in highly nonequilibrium gaseous mixtures and plasmas. Applications to thermionic converters, Langmuir probes, and heat transfer in multicomponent gaseous mixtures are stressed. Detailed results are presented for the case of the Langmuir probe.

Calculated probe current–voltage characteristics show a smooth transition from known collisionless to highly collisional limits. In all cases, absorbing probe boundary conditions are satisfied exactly. Departures from equilibrium are shown to exist in the probe sheath under both highly collisional and collisionless conditions. The practical importance of correctly describing departures from equilibrium near boundaries is evaluated, and the conditions under which equilibrium approximations are adequate are identified. (auth)

9797 STATISTICAL THEORY OF MARKOVIAN PLASMA TURBULENCE. Thomson, J. J. Irvine, CA; Univ. of California (1972). 117p. University Microfilms Order No. 73-11,662.
Thesis (Ph. D.).

The problem of plasma turbulence is considered under the assumption that the turbulent spectrum is sufficiently broad that the particles undergo a Markovian interaction with the stochastic electric fields. Quasi-linear theory is reviewed, and its shortcomings (secularity and nonconvergence), which may be remedied by using a new particle propagator containing the perturbing effect of the turbulent fields on trajectories, are discussed. This method was originally proposed by Dupree. His original paper is reviewed and compared to a later analysis by Rudakov and Tsytovich to find the common assumptions. Following the method of the above authors, but eliminating the k-dependence of their diffusion coefficient, a perturbation series is formed using a perturbed particle propagator and it is shown that the condition for convergence of the series is that no particles are trapped. The full form of the propagator is calculated instead of the approximate form of previous authors. Next, the viewpoint that the particle propagator (or Green's function) is the probability distribution function for the trajectory of a test particle in phase space is taken. Using the Markovian assumption and simple probability theory arguments the same result is calculated for the propagator and also very general expressions for the diffusion coefficient and the dielectric function are given. One finds new damping terms due to the diffusive spread in velocity space ignored by other authors. This treatment is generalized to include a strong magnetic field. A diagrammatic theory is derived for the Markovian Green's function. Finally, this turbulence theory is applied to the current-driven drift-dissipative mode. It predicts that, as current is increased, the mode frequency decreases, and the mode will be destroyed at a critical current independent of mode frequency. Experimental data are shown that corroborate the theory. (Diss. Abstr. Int., B)

9798 PLASMA DIFFUSION IN TWO DIMENSIONS. Williamson, J. H. (Culham Laboratory, Abingdon, Berkshire, England). Phys. Fluids 16: No. 2, 315-320 (Feb 1973).

The nonlinear differential equations describing the interaction of waves in a two-dimensional guiding Center plasma form the basis for computer simulation. The method is often more efficient than the particle codes now in use, and it is readily modified to allow direct computation of ensemble averages. It is shown that the electric field correlation and the particle velocity correlation are not equivalent and so estimates of the diffusion coefficient based on the field correlation are pessimistic. Polarization drifts seem to have little effect on the results until ω_p exceeds ω_c. (auth)

9799 THEORY AND NUMERICAL SIMULATION ON PLASMA DIFFUSION ACCOSS A MAGNETIC FIELD. Okuda, Hideo; Dawson, John M. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 3, 408-426 (Mar 1973).

The diffusion of two and two and a half-dimensional plasmas across magnetic fields have been studied theoretically and by numerical simulation. Only diffusion at thermal equilibrium is studied. It is found that there are three regions; for sufficiently weak magnetic fields the diffusion coefficient is the classical one with $D_\perp$ going like B^{-2}, for moderate magnetic fields ($\omega_{ce} \approx \omega_{pe}$) the diffusion rate is enhanced and $D_\perp$ is almost independent of B, and finally for very large fields ($\omega_{ci} > \omega_{pi}$) the diffusion coefficient goes like B^{-1}. The enhanced diffusion at moderate and high magnetic fields is dominated by collective modes; i.e. by thermally excited convective modes. Theory and simulation are in good agreement. It is also shown that the diffusion coefficient behaves essentially the same way for a three-dimensional plasma when the magnetic field lines are closed. (auth)

9800 SHIELDING OF A SLOW TEST CHARGE IN A COLLISIONAL PLASMA. Stenflo, L.; Yu, M. Y.; Shukla, P. K. (Department of Plasma Physics, Umeå, Sweden). Phys. Fluids 16: No. 3, 450-452 (Mar 1973).

The potential of a slowly moving test charge is considered. Collisional effects are described by a simple BGK model as well as a Lorentz model. It is found that the far-field potential may fall off as the inverse square of distance when the collision frequency is larger than the plasma frequency. (auth)

9801 QUASINEUTRAL SCALING LAWS. James Elliott, C. (Mason Laboratory, Yale University, New Haven, Connecticut 06520). Phys. Fluids 16: No. 2, 333-334 (Feb 1973).

Utilizing the Boltzmann equation we develop scaling laws for a quasineutral plasma. Any binary collision process is allowed but radiative processes, three-body collisions, and self-magnetic fields are not allowed. The independent variables appropriate to a cylindrical discharge are given. (auth)

9802 CONDUCTIVITY OF A TOROIDAL PLASMA. Conner, J. W.; Grimm, R. C.; Hastie, R. J.; Keeping, P. M. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 13: No. 2, 211-214(Mar 1973).

The effect of particle trapping on the conductivity of a toroidal plasma is investigated, taking account of like-particle collisions. The customary large-aspect-ratio approximation is not invoked, and results applicable to all aspect ratios are obtained. These agree with the previously known asymptotic results. (auth)

9803 POSSIBLE DIRECT MEASUREMENT OF CONDUCTIVITY COEFFICIENTS $K_{2,1}$ IN TOKAMAK EXPERIMENTS. Cotsaftis, M. (EURATOM–CEA, Fontenay-aux-Roses, France). Phys. Lett.; 44A: No. 2, 125-126(21 May 1973).

A formula explicitly giving the conductivity coefficients is derived when using some properties of the heat equation. As a consequence, a procedure for measuring these coefficients is suggested. (auth)

9804 A GENERALIZATION OF THE EQUATIONS GOVERNING THE EVOLUTION OF A PARTICLE DISTRIBUTION IN A RANDOM FORCE FIELD. Newman, C. E. (Institute for Plasma Research, Stanford University, Stanford, California). J. Math. Phys. (N.Y.) 14: No. 4, 502-508 (Apr 1973).

The problem of a system of charged particles moving in a random force field and its application to the study of turbulent plasmas are discussed. We point out the inapplicability of existing formalisms to many cases of astrophysical interest. A generalization of this formalism is developed from two different points of view—a Fokker–Planck approach and a quasilinear approach. Both approaches lead to the same equation for the evolution of the particle distribution; this equation has the form of a Fokker–Planck equation, but the terms describing the effects of the random field do not retain the interpretation which they have in usual Fokker–Planck development. It is shown that this equation reduces to a quasilinear diffusion equation when the random field is electromagnetic. (auth)

Production

9805 (SLA-73-5470) APPLICATIONS OF HIGH-INTENSITY RELATIVISTIC ELECTRON BEAMS TO PULSED FUSION AND COLLECTIVE ION ACCELERATION. Yonas, G. (Sandia Labs., Albuquerque, N. Mex.). 1973. 62p. Dep. NTIS $5.25.

These lectures are concerned primarily with phenomena occurring inside vacuum diodes of electron-beam accelerators and the manner in which these phenomena can affect applications to pulsed fusion and collective ion acceleration. Methods of achieving desired beam conditions in diodes and conditions affecting the particular application are discussed. Specific applications include plasma heating and ion acceleration where beams of small angular spread are desired, and pellet ignition where large beam angles are applicable. In order to explain the dynamics of diodes, it is first necessary to consider the mechanisms of plasma formation in such diodes. The mechanisms governing the electron motion in the vacuum, as well as plasma-filled regions, for both low and high ν/γ diodes are discussed. A method of extending the self-pinched high ν/γ diode behavior to create conditions interesting for application to heating of pellets to thermonuclear temperatures is outlined. Finally, examples of collective ion acceleration in diodes are considered, and then the effect of diode conditions on properties of ion acceleration in drifting beams is described. (MOW)

9806 (UCRL-50021-72-2) LASER-FUSION PROGRAM SEMI-ANNUAL REPORT, JULY–DECEMBER 1972. Sussman, S. S.; Clements, W.; Shaw, G. (Eds.). (California Univ., Livermore. Lawrence Livermore Lab.). 9 Feb 1973. Contract W-7405-eng-48. 157p. Dep. NTIS $7.60.

Research progress is described for each of the following areas: (1) solid-state lasers, (2) gas lasers, (3) component development, (4) diagnostics, (5) design analysis, (6) basic studies and advanced concepts, (7) laser plasmas, and (8) laser fusion. (MOW)

9807 ORIGIN OF HOT IONS OBSERVED IN A MODIFIED PENNING DISCHARGE. Roth, J. Reece (Lewis Research Center, National Aeronautics and Space Administration, Cleveland, Ohio 44135). Phys. Fluids 16: No. 2, 231-236 (Feb 1973).

Ions with a Maxwellian energy distribution and kinetic temperatures

ranging from below 100 eV to several keV have been observed in a steady-state modified Penning discharge. Observations in the plasma, with capacitive probes at several azimuthal locations, are consistent with the existence of two distinct spokes rotating with different velocities in the sheath between the plasma and the anode ring. The faster (0.3–10 MHz) spoke consists of electrons rotating with the E/B drift velocity. The slow (0.06–0.8 MHz) spoke consists of ions, the measured thermal velocity of which is directly proportional to the spoke volocity. The interaction of the two spokes is apparently responsible for the observed electrostatic "turbulence" and ion thermalization. The anode sheath thickness is smaller than the ion gyrodiameter in this plasma. Thus, the ions are in the electric field of the sheath for only a fraction of their orbit, and their E/B drift (spoke) velocity is smaller than that of the electrons. (auth)

9808 NEW PERSPECTIVES ON LASER-INDUCED FUSION. Eidmann, K. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Atomwirt., Atomtech.; 18: No. 4, 204-206(1973). (In German).

New data and results of experiments on laser-induced plasma throughout the world are discussed. The concepts are based on the compression of fusion fuels to densities lying orders of magnitude (10^3 to 10^4 times) higher than normal solid densities. The aim is to achieve a significant reduction of the necessary break even laser energies to technically realizable values. The selection of the laser type and the power demands of the laser beam are still unsolved. A short status of the work in the most important research centers is given. (GE)

9809 PLASMA REACTOR. Tschesnokov, N. A.; Stelmach, G. P.; Zachiev, A. S.; Rykalin, N. N. German Patent 1,932,703. 5 Oct 1972. Filed date 27 Jun 1969. 8p. (In Russian).

A plasma reactor with a ring anode for forming chemical-physical transformations in an arc gas discharge plasma was described. The stabilized arc discharge is formed in a magnetic field. A plasma beam issuing from a linear arc chamber in the reaction chamber coincides with the axis of the ring and is the cathode belonging to this ring anode. Between the ring anode and the plasma beam there is a gas discharge filling the total reaction volume of the gas discharge. The walls of the arc chamber consist of electrically insulated cooled sections. (JSR)

9810 UNIFIED POSITIVE COLUMN THEORY OF GAS DISCHARGES. Cohen, Ira M.; Whitman, Alan M. (The Towne School of Civil and Mechanical Engineering, University of Pennsylvania, Philadelphia, Pennsylvania 19104). Phys. Fluids 16: No. 2, 307-314 (Feb 1973).

The effects of electron impact ionization, three-body recombination, and a thermal energy balance are considered on the positive column of a gas discharge confined between plane parallel walls. The diffusion flux equations (with temperature-dependent ionization and recombination) for conservation of ions and electrons, Poisson's equation for the self-consistent electric field, and the Elenbaas-Heller energy equation for the temperature distribution, are used. Thermal and electrical conductivities are given by mixture rules that are linear interpolations of collision cross sections in fraction ionized. This formulation allows the description of the entire range of gas discharges from dark discharges through arcs. The emphasis here is devoted to the range from the normal glow through the transition to an arc. The end result is the calculation of semi-internal characteristics, ionization collision rate versus current (per unit depth), and electric field versus, current (per unit depth). It is found that the ionization rate has a maximum and the electric field a minimum in the arc domain. (auth)

9811 GROSS DYNAMICS OF A HIGH PRESSURE HELIUM DISCHARGE. Peatman, Wm. B. (Chemistry Department, Vanderbilt University, Nashville, Tennessee 37235); Barach, John P. J. Chem. Phys. 58: No. 6, 2638-2647 (15 Mar 1973).

The spectroscopic and plasma characteristics of a brief (200 nsec) repetitive discharge in 50 torr of helium are approximately determined. Time resolved spectroscopic analysis of the divers atomic and molecular species is employed over the entire discharge period from 100 nsec prior to breakdown to 115 μsec afterwards. Discussion of the discharge is focused on three distinct periods: the arc period, comprising the first 200 nsec after initiation of the excitation pulse; the plasma or cool period, 200–1100 nsec; and the afterglow, 1100 nsec and beyond. Coupled differential equations representing the time dependent concentration of each species are solved approximately and are found to be in general agreement with the spectral data. The energy storage modes for the several periods are obtained. Particular comments on the 600 Å bands of the helium molecule are made. (auth)

9812 PRESSURE DEPENDENCE OF SELF-GENERATED MAGNETIC FIELDS IN LASER-PRODUCED PLASMAS. Bird, R. S.; McKee, L. L.; Schwirzke, F.; Cooper, A. W. (Naval Postgraduate School, Monterey, California 93940). Phys. Rev. A 7: No. 4, 1328-1331 (Apr 1973).

The systematic dependence of the magnitude of the self-generated magnetic fields of a laser-produced plasma on nitrogen background pressure has been investigated. At expansion distances of a few millimeters or more, the strongest fields were found to reside at the front of the streaming laser plasma. Magnetic fields were created in the laser plasma long after laser shut off by allowing the streaming plasma to impinge upon a glass plate. (auth)

9813 QUASIMODO—A DEVICE FOR SUSPENDING SMALL SOLID TARGETS AT THE FOCUS OF A HIGH POWER LASER. van Hulsteyn, D. B.; Anderson, L. (Department of Electrical Engineering, The University of Texas at Austin, Austin, Texas 78712). Rev. Sci. Instrum. 44: No. 4, 453-456 (Apr 1973).

Using a magnetically retracted pedestal, small targets of a solid material can be accurately positioned at the focus of a laser pulse. The particular system to be described is relatively inexpensive, has proved capable of holding a vacuum of the order of 10^{-8} Torr, and has provided successful firings in more than 95% percent of the attempts. It has the added advantage of being easily adaptable to a variety of applications, such as toroidal confinement devices, mirror or minimum B machines, Z and Θ pinch systems and plasma focus devices. (auth)

Stability

Refer also to abstracts 9029, 9316, and 9915.

9814 (IPP-2/209) USE OF RESONANCE FOR THE DYNAMIC STABILIZATION OF THE RAYLEIGH-TAYLOR INSTABILITY AND FOR THE EXCITATION OF THE RELATED PARAMETRIC INSTABILITIES. Holitzner, H.; Wolf, G. H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

The dynamic stabilization of the hydrostatic Rayleigh-Taylor instability and the excitation of the related short wavelength parametric instabilities (resonances) require the application of enforced oscillations vertically to the unstable interface. The use of the resonance between the frequency of these oscillations and the appropriately chosen eigenfrequency of the overall system allows operation in regions of the stability regime which are difficult to reach otherwise. An air cushion between the body of liquid and the vibrator which delivers the enforced oscillations can be used as the spring determining this eigenfrequency instead of the familiar mechanical elements. (auth)

9815 (IPP-6/117) STABILITY OF TWO-DIMENSIONAL COLLISION-FREE PLASMAS. Schindler, K.; Pfirsch, D.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1973. 43p. Dep. NTIS (U. S. Sales Only) $4.25.

The stability of plasma equilibria is analyzed in the framework of two-dimensional Vlasov theory, where the perturbations are constant along the direction of the equilibrium current. The method makes use of several general properties of the equations, thus covering a rather large class of different configurations. Several necessary and sufficient stability criteria and an expression for the growth rates are derived. In particular, the results are applicable to equilibria containing neutral points. A number of earlier results (e.g., the tearing mode) are recovered by appropriate specialization. (auth)

9816 (IPP-III-7) MULTIPOL-TOKAMAK EQUILIBRIA. Feneberg, W.; Lackner, K. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1973. 33p. Dep. NTIS (U. S. Sales Only) $3.75.

Solutions are given for axisymmetric MHD equilibria obtained by superposing the magnetic field of the plasma currents and the field of current carrying conductors situated outside the plasma. These equilibria were numerically calculated by several different iteration methods for solving the nonlinear free-boundary problem. They can describe experiments in which the discharge time is long compared with the diffusion time of the magnetic field through the external conducting walls. Equilibria were obtained both for approximately circular plasma cross sections and strongly elongated (elliptical) ones. Such calculations are of interest for constructing axisymmetric Tokamak divertors, as well as for producing elongated cross sections, which have been postulated to be stable for higher values of plasma pressure. The results are restricted to the case of zero plasma pressure and a particular current distribution in order to reduce the number of free parameters and allow more detailed discussion of the dependence of the equilibrium configurations on the arrangement of the external conductors and the currents. (auth)

9817 GROWTH RATES AND SPECTRA FOR A PARTICULAR AXIALLY SYMMETRIC EQUILIBRIUM. Weitzner, Harold (Courant Institute of Mathematical Sciences, New York

University, New York, New York, 10012). Phys. Fluids 16: No. 2, 237-246 (Feb 1973).

An axially symmetric ideal magnetohydrodynamic equilibrium akin to a mirror machine with currents only in the ignorable direction is considered. In order to study the spectrum of modes and growth rates of unstable modes, an expansion is performed in the small parameter, the ratio of plasma radius to axial periodicity length. Many stable continuous spectra and both stable and unstable point spectra are found. Growth rates are computed after a second expansion is made in the small parameter, the fractional distortion of the flux surfaces from cylinders. The high-beta wall stabilization effect first noted by Haas and Wesson in their free boundary model is not found in this distributed pressure model which is not a good approximation to theirs. Aside from this one difference, the growth rates here are quite comparable to the sharp boundary model and give further indication of the utility of that model. (auth)

9818 STABILITY OF TWO-DIMENSIONAL MAGNETOHYDRODYNAMIC EQUILIBRIA. Freidberg, J. P.; Marder, B. M. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico). Phys. Fluids 16: No. 2, 247-253 (Feb 1973).

A numerical procedure is presented for computing the stability of high β, diffuse two-dimensional magnetohydrodynamic equilibria. The method is tested on the problem of the bumpy θ pinch with arbitrary size bumpiness. (auth)

9819 GRADIENT-INDUCED INSTABILITIES. Newton, R. H. C.; Short, D. M. (University Coll. of North Wales, Bangor). J. Phys., A (London); 6: No. 5, 722-732(May 1973).

It is shown that the unstable behavior of a single-carrier stream in the presence of a carrier density gradient is due to wave interaction between an active mode and a passive mode: modes which do not couple when the carrier density is uniform. (auth)

9820 SATURATION OF KINETIC PLASMA INSTABILITIES BY PARTICLE TRAPPING. Dewar, R. L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). Phys. Fluids 16: No. 3, 431-435 (Mar 1973).

The amplitude at which a single unstable langmuir or ion-acoustic wave in a collisionless plasma saturates due to electron trapping is estimated using both the adiabatic and sudden approximations, and is shown to obey the approximate relation $\omega_b \approx 3\gamma_{lin}$. This is found from momentum conservation. It is found that energy conservation implies a nonlinear dispersion relation that is linearly independent of that derived from Poisson's equation, but that a reasonable distribution of resonant particles can be found that satisfies both relations. (auth)

9821 LOW-FREQUENCY PARAMETRIC INSTABILITIES OF MAGNETIZED PLASMAS WITH TWO-ION SPECIES. Ott, Edward; McBride, John B.; Orens, Joseph H. (Naval Research Laboratory, Washington, D. C. 20390). Phys. Fluids 16: No. 2, 270-276 (Feb 1973).

A theoretical and computer simulation treatment of the response of magnetized plasmas with two-ion species to low-frequency, electric fields oscillating at ω_0 near the lower-hybrid frequency ω_{lh} that shows the existence of parametric instabilities. A new decay instability involving the Buchsbaum two-ion resonance occurs for $\omega_0 > \omega_{lh}$, and a purely growing instability occurs for $\omega_0 < \omega_{lh}$. The analysis is valid even when the masses of the ion components are comparable and applies, for example, to deuterium-tritium plasmas. Computer simulation experiments demonstrate the potential importance of these instabilities as ion heating mechanisms. (auth)

9822 ELECTROMAGNETIC INSTABILITY IN INTERPENETRATING ELECTRON-ION PLASMAS. Chen, W. M.; Lai, C. S. (Department of Physics, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada). Phys. Fluids 16: No. 2, 277-281 (Feb 1973).

The electromagnetic instability associated with plasma waves propagating perpendicular to a uniform magnetic field $\vec{B}_0$ is studied for counterstreaming electron-ion plasmas, based on the linearized Vlasov-Maxwell equations. Owing to the different densities, temperatures, and drift velocities of two plasma streams, the plasma waves can no longer be separated into the ordinary and extraordinary modes. It is found, as in the case of two identical counterstreaming plasmas, that the instability can occur in rather low-β plasmas and the typical growth rate is of the order of the electron cyclotron frequency. (auth)

9823 NONLINEAR THEORY OF THE E×B ELECTRON DRIFT INSTABILITY IN HIGH-β PLASMAS WITH $T_i \approx T_E$. Rogister, André (European Space Research Institute of the European Space Research Organization, Frascati, Italy). Phys. Fluids 16: No. 2, 282-293 (Feb 1973).

A nonlinear theory of the E×B electron drift instability for $T_e \approx T_i$ is developed on the basis of the wave kinetic equation for weakly turbulent plasmas in a uniform magnetic field. It is found that nonlinear electron cyclotron resonances stabilize short wavelength—but destabilize long wavelength modes; the total wave energy, however, is stabilized by this mechanism. In a two-dimensional model (the waves propagate in a narrow fan encompassing the plane orthogonal to B), wave-wave scattering processes can transfer energy from the unstable small k region of the spectrum toward larger k's where nonlinear electron damping dominates. Either balancing the relevant stabilizing and destabilizing processes for small k's, or considering over-all energy balance, predicts that the theoretical turbulence level at $k = k_D$ (the inverse of the Debye length) is a few hundred times thermal. The estimated effective electron-ion collision frequency is found to be much too small to explain the anomalous heating observed in collisionless orthogonal shocks suggesting that another instability, not confined to propagate in a narrow fan, is required to explain the anomalous resistance. (auth)

9824 TRANSVERSE DYNAMIC STABILIZATION OF A THETA PINCH. Lister, G. G.; Troyon, F. S.; Weibel, E. S. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Phys. Fluids 16: No. 2, 297-306 (Feb 1973).

The stability of a straight plasma column confined by a static axial magnetic field and a small oscillating transverse magnetic field is discussed. Growth rates for the most important parametric instabilities are obtained. The influence of damping in providing a stabilizing mechanism against these instabilities is discussed, and a set of stability criteria are obtained using a viscous fluid model for the plasma. The possibility of suppressing the fastest growing instability by "wobbling" the frequency of the applied field is also discussed. An order of magnitude calculation for dynamic stabilization of a toroidal plasma is presented. (auth)

9825 BEHAVIOR OF RELATIVISTIC BEAMS UNDERGOING HOSE MOTION IN A PLASMA CHANNEL. Moses, K. G.; Bauer, R. W.; Winter, S. D. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). Phys. Fluids 16: No. 3, 436-442 (Mar 1973).

A 6-MeV electron beam with current of 100-200 A was used to study the hose instability of a relativistic electron stream. The growth rates of the instability were experimentally determined, and measured values diplayed the trends predicted by theoretical analyses. The magnitude and position of the maximum growth rate as related to the perturbing frequency and plasma-current decay times agreed well with the predictions of both the rigid and nonrigid beam models. The general dependence of growth rate on the ratio of channel radius to beam radius was observed. (auth)

9826 DRIFT INSTABILITIES DISTORTING THE MAGNETIC SURFACES OF TOKAMAK-TYPE TOROIDAL SYSTEMS. Mikhailovskii, A. B. Nucl. Fusion; 13: No. 2, 259-269(Mar 1973).

Attention is drawn to the fact that the theory of "drift" instabilities of toroidal systems has hitherto made no allowance for the type of instability associated with Alfvén waves. The presence of this type of instability is demonstrated for the case of an axisymmetric tokamak with circular cross section. A general method is developed for investigating Alfvén-type instabilities and it is shown that the problem is essentially one of finding the "nonhydromagnetic" part of the perturbed plasma pressure. This kind of general approach is used for analyzing plasma perturbation in conditions where the influence of finite conductivity and trapped particles is insignificant. It is shown that these perturbations can increase with time, if the plasma temperature gradient is non-zero. The perturbations investigated involve electrons and ions being displaced radially at an almost equal rate, so that the instabilities considered should lead not only to increased thermal conductivity but also to increased diffusion. (auth)

9827 DECAY INSTABILITY OF NONLINEAR COLLISIONLESS DRIFT WAVES. Demshenko, V. V.; El-Nagger, I. A.; Hussein, A. M. (Atomic Energy Commission, Cairo). Nucl. Fusion; 13: No. 2, 285-288(Mar 1973).

Analytical expressions for the nonlinear drift wave profiles in a collisionless anisotropic plasma were obtained earlier (Zhmudsky, A. A., et al., Nucl. Fusion 10, 151(1970). Solutions were derived both for the periodic structure of drift waves and solitary waves (solitons). The authors could also demonstrate that the nature of a wave (compression, rarefaction) is totally governed by $\eta = d(\ln T)/d(\ln n)$ and the form of the distribution function. At the same time, a conclusion was made about the stability of the solutions. It is demonstrated that the solutions obtained earlier are actually unstable. It is found out that the instability is a "decaying" one; the condition of the instability and the growth rates of unstable oscillations are specified. (MOW)

9828 ELECTROSTATIC INSTABILITIES DRIVEN BY AN ELECTRIC CURRENT PERPENDICULAR TO A MAGNETIC FIELD. Lashmore Davies, C. N.; Martin, T. J. (Culham Lab., Abingdon, Eng.). Nucl. Fusion; 13: No. 2, 193-203(Mar 1973).

The linear stability problem of a current flowing perpendicularly to a magnetic field is analyzed. With the restriction that the growth rate should be larger than the ion cyclotron frequency, all the fast-growing electrostatic modes are computed and compared. It is argued that the most significant modes of the problem (relevant to perpendicular collisionless shocks, pinches and the plasma focus) can be obtained without inclusion of effects due to gradients of the equilibrium quantities. The computations are divided into three broad categories: $T_e \gg T_i$; $T_e = T_i$; and $T_i = 10\ T_e$. With the aid of computation and analysis an attempt was made to cover the whole range of parameter space for this problem. (auth)

9829 PARAMETRIC INSTABILITY IN THE REGION OF LOW-FREQUENCY HYBRID RESONANCES. Demchenko, V. V.; El-Naggar, I. A. (Atomic Energy Commission, Cairo). Nucl. Fusion; 13: No. 2, 205-210(Mar 1973).

The nonlinear longitudinal oscillations of a homogeneous plasma embedded in a weakly inhomogeneous magnetic field in the presence of an external high-frequency field are investigated. The nonlinearity of oscillations is manifested in two ways: (a) allowance for the terms $(\tilde{v}\nabla)\tilde{v}$ in the equations of motion and (b) dependence of the plasma natural oscillation frequency on the displacement amplitude (or, otherwise, the loss of isochronity). It is demonstrated that the terms $(\tilde{v}\nabla)\tilde{v}$ do not restrict the amplitude increase in the regions of hybrid resonances. The nonlinear terms arising in the equations of motion governed by the inhomogeneity of $\tilde{B}_0$, item (a), restrict the oscillation amplitude in the resonant areas and, item (b), lead to a parametric buildup of oscillations. The conditions for the parametric instability and the growth rates of unstable oscillations are determined. (auth)

9830 SATURATION SPECTRUM OF THE ION-ACOUSTIC INSTABILITY IN A CURRENT-CARRYING PLASMA. Tu Khiet (Paris Univ., Orsay, France). Phys. Lett.; 44A: No. 2, 83-84 (21 May 1973).

The effect of resonance broadening on the saturation of the ion-acoustic instability is studied. (auth)

9831 INSTABILITY OF MAGNETOACTIVE PLASMA WITH ANISOTROPIC ION VELOCITY DISTRIBUTION IN THE FIELD OF AN ELECTROMAGNETIC WAVE. Bondarenko, V. I.; Kats, M. Yu.; Yukhimuk, A. K. (Inst. of Geophysics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 4, 335-338(Feb 1973). (In Ukrainian).

A dispersion equation for plasma in the presence of an external magnetic field is analyzed. The condition is obtained for generation of longitudinal low-frequency fluctuations of plasma with anisotropic ion velocity distribution in the presence of an external electromagnetic field. It is assumed that the field of an electromagnetic wave gives rise to the electron drift but does not change the ion anisotropy. (auth)

9832 FEEDBACK STABILIZATION OF MULTIMODE TWO-STREAM INSTABILITY. Chervin, R. M.; Sen, A. K. (Columbia Univ., New York). Plasma Phys.; 15: No. 5, 387-397(May 1973).

Various theoretical schemes for the feedback stabilization of a multimode two-stream instability in a finite one-dimensional plasma are presented. The system under consideration is the fluid analog of the symmetric "bump on the tail" Vlasov plasma. The most promising feedback scheme involves sensing the total density perturbation and feeding back an appropriate charge. It is shown that, by proper choice of feedback parameters in a single feedback loop, all unstable modes can be stabilized without destabilizing any modes which were previously stable. (auth)

9833 LONG-WAVELENGTH INSTABILITY IN A PERPENDICULAR SHOCK. Gary, S. P. (College of William and Mary, Williamsburg, VA). Plasma Phys.; 15: No. 5, 399-410(May 1973).

Electrostatic waves in a Vlasov plasma of unmagnetized ions and magnetized electrons undergoing E x B and gradient-B drifts are considered. The linear dispersion relation is solved numerically with particular attention given to directions of propagation away from the perpendicular to B and wavelengths longer than the electron gyroradius. The results lead to the conclusion that this "modified two-stream instability" is probably not important in perpendicular resistive shocks. (auth)

9834 MAGNETO-VISCOUS EFFECTS ON THE IDEAL AND RESISTIVE GRAVITATIONAL INSTABILITIES IN CARTESIAN THEORY. Hosking, R. J.; Marinoff, G. M. (Waikato Univ., Hamilton, New Zealand). Plasma Phys.; 15: No. 5, 327-341 (May 1973).

Calculations derived from a closed form for the nonhydrostatic stress tensor for a stratified fully ionized plasma are presented. All the existing results relevant to the potential stabilization of the ideal and resistive gravitational instabilities are then obtained. A new result given is that the weakly localized resistive-g instability of stratified plasma in a uniform magnetic field is slowed down due to the ion "perpendicular" viscosity at lower temperatures, but is essentially unmodified at higher temperatures. It is noted that the "parallel" viscosity is quite unimportant in the present Cartesian theory, and that a proper treatment of the influence of magnetic field curvature may well be needed. (auth)

9835 OBSERVATION OF RADIALLY PROPAGATING COLLISIONLESS-DRIFT-WAVE INSTABILITY. Nishida, Y.; Dodo, T.; Kuroda, T.; Horikoshi, G. (Institute of Plasma Physics, Nagoya University, Nagoya, Japan). J. Appl. Phys. 44: No. 4, 1541-1542 (Apr 1973).

The radially traveling drift-wave instability is observed in a fully ionized collisionless plasma. The observed radial wave number is larger than the azimuthal wave number. The observed frequency, in the frame of $E_r b_z$ plasma rotation, is in good agreement with the calculated frequency of the drift instability after the correction of finite ion inertia including the radial wave number, where E_r is a radial electric field and B_z is an axial magnetic field. (auth)

9836 INSTABILITIES OF ELECTRICALLY EXPLODED WIRES. Vlastós, Antonios E. (The Royal Institute of Technology, 100 44 Stockholm 70, Sweden). J. Appl. Phys. 44: No. 4, 1616-1621 (Apr 1973).

The experimental results summarized in this paper, which have been obtained with thin tungsten, copper, and constantan wires, give further evidence that electromagnetic macroinstabilities may develop near the melting point of thin wires which are heated by the sudden release of electrical energy and lead to their disintegration. At low-energy-input rates, screw-type instabilities develop in all the wire materials used. On the other hand, at high-energy-input rates, the copper and constantan wires show striations after the explosion, while tungsten wires are not striated but are split into tiny fibers which emerge along the whole wire. At the beginning the restrike channel of copper and constanstan wires has an helicoidal form. Annealed wires show the same results. Helical channels were not observed in tungsten wires. By twisting the copper and constantan wires in the opposite direction to the channel helix, it was possible to change the direction of the helix. Thus, the helical shape of the channel may be an effect produced by the twisting of the wire in mounting it between the electrodes. The possibility that the helicoidal shape of the channel is due to some other effect is also discussed. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 8054 and 8079.

9837 (AD-753107) STUDY OF VORTEX ANNIHILATION AND NEUTRON PRODUCTION. Final Scientific Report, 1 October 1971-30 September 1972. Bostick, W. H.; Nardi, V.; Prior, W. J. (Stevens Inst. of Tech., Hoboken, N. J.). Oct 1972. 10p. (SIT-P-274. AFOSR-TR-72-2426). NTIS.

Highly-localized x-ray sources in the plasma focus are shown to be the central channels of toroidal vortices. The decay of the magnetic fields of these toroidal vortices generates electric fields that accelerate the electrons and deuterons to produce x rays and neutrons. Estimated electron densities in the channel are 10^{20}/cm^3 and magnetic fields up to 100 MG are believed to exist there. A viable model for neutron and x-ray production in the pinch effect has now at last come forward. (auth)

9838 (BNL-17875) FUSION REACTIONS IN COLLIDING BEAMS. Blewett, J. P. (Brookhaven National Lab., Upton, N. Y.). 27 Apr 1973. 22p. Dep. NTIS $3.25.

A system of beams of deuterons and tritons traveling in the same direction and focused by a relativistic electron beam is shown to be capable of yielding kilowatts of fusion power per meter of beam path. (auth)

9839 (IPP-4/107) CALCULATION OF TRANSIENT CURRENTS AND FORCES IN TOROIDAL COIL SYSTEMS FOR FUSION MACHINES. Poehlchen, R.; Preis, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jan 1973. 23p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

Methods are discussed for calculating the electrical behavior of toroidal coil configurations and the magnetic forces in the coil system in cases of sudden disturbance of normal (stationary or quasi-stationary) operation. After it is shown how to calculate the self-inductances and mutual inductances of the coil system, an explanation is given of the mesh scheme for obtaining the matrix equations of the network. The currents thus calculated are then used to determine the total magnetic field and hence the Lorentz

forces. In the example given, inductances, current distributions and forces are calculated for the superconducting version of the Stellerator W VII at Garching. (auth)

9840 (IPP-4/108) OPTIMIZATION OF SUPERCONDUCTING TOROIDAL MAGNETS FOR TOKAMAK FUSION REACTORS. Schmitter, K. H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Jan 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

Questions concerned with the optimization of toroidal magnets for tokamak fusion reactors are discussed, in particular, with regard to the conductor costs. (auth)

9841 (IPP-III-6) TOKAMAK WITH AN IMMATERIAL SEPARATRIX LIMITER. Lehner, G.; Pohl, F. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Feb 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

Present-day Tokamak experiments suffer from serious disadvantages due to the presence of a material limiter, the shell providing the equilibrium, and the transformer with its flux problems. Perhaps the most feasible solution of the limiter problem could be obtained by using a magnetic separatrix as an immaterial limiter as proposed by Feneberg (Phys. Lett., 36A: 125(1971)). Examples indicate that the multipole currents used to generate such a separatrix configuration can also solve the other problems, i.e., they can be chosen such that they provide plasma equilibrium and also serve as primaries of an air-core transformer. Another advantage of such a Tokamak machine is that it can be built with an axisymmetric divertor. (auth)

9842 (IPPJ-141) CRITICAL β_p IN A TORUS WITH RECTANGULAR CROSS SECTION. Suzuki, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Oct 1972. 14p. NTIS (U. S. Sales Only).

A simple diffused-boundary model is considered for magnetohydrodynamic equilibrium in an axisymmetric torus with rectangular cross section. The pressure balance equations are reduced from the expressions for eigenvalues of the equilibrium equation. The parameter β_p (ratio of plasma pressure to poloidal magnetic pressure) is closely related to the paramagnetism of plasma and geometrical factors. The condition of no reversed toroidal current gives the limitation on the paramagnetism and β_p. The critical β_p becomes largest for the square plasma cross section. (auth)

9843 (JAERI-M-4961) BEHAVIOUR OF IMPURITY IONS IN A TOKAMAK PLASMA. Tanaka, M.; Yoshikawa, M.; Inoue, K.; Tazima, T. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 13p. (In Japanese). NTIS (U. S. Sales Only).

The distribution of impurity ions in a high-temperature plasma column is examined on the basis of a model which takes account of the diffusion processes of the impurity as well as the ionization processes. For a uniform background plasma, analytical solutions are obtained. Stationary distributions of all charge states of oxygen impurity across a plasma column are calculated using the ionization rate coefficients due to Post and Hinnov and neoclassical diffusion coefficients. (auth)

9844 (JAERI-M-5021) MEASUREMENTS OF VERTICAL MAGNETIC FIELDS IN JFT-2. Matsuda, S.; Ohga, T.; Suzuki, N.; Fujisawa, N. (Japan Atomic Energy Research Inst., (Tokyo). Oct 1972. 27p. (In Japanese). NTIS (U. S. Sales Only).

The measurements made of the vertical magnetic fields in JFT-2 are described. These measurements are necessary to obtain information for keeping the plasma column in equilibrium state. The error field measured is discussed in relation to the islands of magnetic surfaces which may appear in the presence of a plasma current. The measured results on a leakage magnetic field outside the plasma region are also presented. (auth)

9845 (MATT-Q-27) ANNUAL REPORT COVERING THE PERIOD JANUARY 1 TO DECEMBER 31, 1969. (Princeton Univ., N. J. Plasma Physics Lab.). Jun 1970. Contract AT(30-1)-1238. 291p. Dep. NTIS $16.75.

Research summaries are given for the following work during this period: (1) spherator and quadrupole experiments, (2) stellarator experiments, (3) alkali plasma experiments, (4) wave interaction experiments, (5) non-MHD instabilities, (6) MHD equilibrium and stability, (7) computer simulation, (8) transport, diffusion, and kinetic theory, (9) lasers, dynamics, and heating, (10) astrophysical applications, and (11) related engineering developments. (MOW)

9846 (ORNL-TM-4120) RELATIVISTIC ELECTRON PRODUCTION IN THE ORMAK DEVICE. Spong, D. A.; Clarke, J. F.; Rome, J. A. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 42p. Dep. NTIS $4.25.

Runaway electron currents were observed in ORMAK of up to 140 kA with energies in the MeV range and lasting for about a tenth of a second. A theory is developed for the production and acceleration of these electrons and is compared with experimental data. (auth)

9847 (ORNL-TM-4184) OUTLINE OF DIRECT METHODS USED IN COMPUTING THE CROSS SECTION SENSITIVITY OF NEUTRONIC PARAMETERS IN A FUSION REACTOR. Tobias, M. L.; Steiner, D. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 53p. Dep. NTIS $4.75.

The methods by which cross-section changes were effected in a sensitivity analysis of neutronic parameters in a D-T fusion reactor are recorded. Listings of auxiliary codes are presented. (auth)

9848 (ORNL-TM-4256) MAGNET SHIELD DESIGN FOR FUSION REACTORS. Kriese, J. T.; Steiner, D. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 28p. Dep. NTIS $3.50.

Current concepts of mirror and Tokamak fusion reactors employ superconducting magnet coils in order to minimize the power requirements of the magnet system. Since most fusion fuel cycles of interest involve the production of high-energy neutrons, adequate shielding must be provided for the cryogenically cooled coils. The magnet shield must limit both nuclear heating and radiation damage in the coil region. The purpose of this paper is to survey alternate shielding materials with regard to their nuclear engineering characteristics in deuterium-tritium (D-T) fusion reactors. The topics considered include (1) nuclear heating, (2) radiation flux levels, (3) estimates of shield material costs, and (4) chemical compatibility considerations. (auth)

9849 (UCRL-50022-4) LLL LASER PROJECTS REPORT NO. 4. Kachen, G. I.; Sussman, S. S.; Clements, W. (Eds.). (California Univ., Livermore. Lawrence Livermore Lab.). Mar 1973. Contract W-7405-eng-48. 35p. Dep. NTIS $3.75.

Ten reprints from LLL reports are included. These deal mainly with development of the laser with some applications to plasma physics. (MOW)

9850 (WASH-1246) POST-1980 REACTOR DEVELOPMENT PROGRAM. (Ad Hoc Committee on CTR Technology (USA)). 30 Jun 1972. 12p. Dep. NTIS $3.00.

The technology developmental program is discussed for the various phases. The reactor development program is next described along with the developmental time scale and cost estimates. (MOW)

9851 DEVICE FOR INDUCING FUSION REACTIONS WITH PULSED LASERS ALIGNED ON FUSIONABLE GASES. Kaiser, W.; Opower, H. German Patent 1,900,524. 8 Apr 1971. Filed date 7 Jan 1969. 6p. (In German).

A device for causing fusion reactions with pulsed lasers aligned on fusionable gases is described. Two tubes in a stationary evacuated chamber are coaxially opposite each other. The gas flows through the pipes. The opening of the pipes have ring slots whose width is smaller than the internal tube diameter. A laser system consisting of several lasers is set up at a distance from the tubes, and the light beam from the laser is aligned on the ring slot. In the region of the pipe openings, the pipes are coated with solid materials containing deuterium and tritium. The coating consists of LiD or LiD-LiT. In the vicinity of the openings, the tubes are shaped as Laval nozzles. The tubes are movable axially. The tubes in the vicinity of the openings are wound with wire for carrying current. The gas flows with sonic or supersonic velocities. The density of the flowing gases in the region of the reaction volume is proportional to the frequency of the irradiated light. The arrangement of the laser and projection systems are aligned so that the light beam on the ring slot converges in a definable focus. A part of the neutron energy given up in a moderator and absorber was transformed directly into usable light energy by means of luminescent materials contained in the moderator and absorber. (JSR)

9852 PROSPECTS FOR FUSION POWER. Post, R. F. Phys. Today; 26: No. 4, 31-39(Apr 1973).

The present status of fusion research is reviewed. The review briefly covers the following topics: (1) physical conditions for fusion, (2) confining the plasma, (3) search for stable configurations, (4) tokamaks, (5) theta pinches, (6) magnetic mirrors, and (7) laser fusion. (MOW)

9853 HYBRID STELLARATOR FIELDS WITH SEVERAL VALUES OF l. Miyamoto, K. (Nagoya Univ., Japan). Nucl. Fusion; 13: No. 2, 179-183(Mar 1973).

The properties of hybrid stellarator fields with different values of l are reviewed as related to the current configuration. The dependence of the rotational transform angle and the necessary helical current on the helical pitch parameter (ma/R), the radius

of the separatrix (ma_s/R), the radial co-ordinates (mr/R), the aspect ratio (a/R) and the number l is studied by using an average method to find the optimum parameters in the case of the linear configuration. These results are compared with the numerical ones in the toroidal stellarator configuration and the agreement is satisfactory in the case of medium aspect ratio ($4 \sim 5$). (auth)

9854 VARIATIONAL METHODS FOR CONTROLLED THERMONUCLEAR REACTOR BLANKET STUDIES. Conn, R. (Univ. of Wisconsin, Madison); Stacey, W. M. Jr. Nucl. Fusion; 13: No. 2, 185-191(Mar 1973).

Variational procedures for neutron and photon transport calculations in CTR blanket studies are considered. The procedures can be readily implemented to yield accurate results in an efficient manner, and will be especially useful in performing sensitivity studies and survey calculations. They are applicable to multidimensional problems and to the time-dependent, as well as the steady-state, case. The use of the dual-space approach for certain sensitivity studies is also considered. Numerical results are presented to demonstrate the efficacy of the procedure discussed. (auth)

Wave Phenomena

Refer also to abstract 9820.

9855 (AD-753257) NONLINEAR WAVE INTERACTION IN A PLASMA COLUMN. Larsen, J. M. (Stanford Univ., Calif. Inst. for Plasma Research). Oct 1972. Contract N00014-67-A-0112-0044. 164p. (SU-IPR-493). NTIS.

A theoretical and experimental study was made of two particular cases of nonlinear wave interaction in a plasma column. The frequencies of the waves are of the order of magnitude of the electron plasma frequency. Ion motions are neglected. The nonlinear coupling of slow waves on a plasma column is studied by means of cold plasma theory. The quasistatic approximation is used to simplify the analysis. The case of a plasma column surrounded by an infinite dielectric in the absence of a magnetic field is also examined. The linear properties of slow waves are reviewed, and solutions are obtained for use in the nonlinear theory. Nonlinear scattering from a plasma column in an electromagnetic field having its magnetic field parallel to the axis of the column is investigated. In the linear regime, the plasma column exhibits series of multipole resonances. A warm plasma analysis using a scalar electron pressure and a nonuniform electron density profile is presented. (auth)

9856 (FEI-359) CONCERNING ASYMPTOTIC SOLUTIONS OF NONLINEAR EQUATIONS OF AUTO-OSCILLATIONS OF A PLASMIC LAYER. Zherebtsov, V. A.; Shut'ko, A. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

Methods of constructing asymptotic solutions of nonlinear equations which describe auto-oscillations in a finite, continuous medium are described. The methods developed are generalized from the methods of Krylova-Bogolyubov and Lyapunoba-Puankare. Cases of auto-oscillations in a plasma layer are considered in detail. (tr-auth)

9857 (IPPJ-137) NONLINEAR SCHROEDINGER EQUATION FOR LANGMUIR WAVES. Fried, B. D.; Ichikawa, Y. H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Aug 1972. 39p. NTIS (U. S. Sales Only).

A direct derivation of the nonlinear Schroedinger equation for Langmuir waves is presented, based upon the nonlinear wave packet theory of Karpman and Kruskal. Both fluid and Vlasov equation formulations are used. The results obtained are essentially equivalent to those found earlier by Taniuti et al. using reductive perturbation theory, including the importance of wave particle resonances at the group velocity for the long time behavior of the amplitude of modulated waves. Separating the wave-packet considerations from the calculation of the nonlinear frequency shift makes it possible to attack the latter with whatever method facilitates the analysis of that part of the problem. In addition, certain ambiguities concerning singularities in velocity integrations are resolved, and the connection with a well-posed initial-value problem is made somewhat clearer. (auth)

9858 (ITF-73-8-E) NONLINEAR WAVE INTERACTION AND FLUCTUATIONS IN PLASMA. Sitenko, A. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

Collective fluctuations in nonequilibrium plasma with nonlinear wave interaction are considered. The four-wave interaction is the main nonlinear effect when three-wave resonances are absent. This interaction causes an eigenfrequency shift proportional to the oscillation intensity. The proportionality coefficient is determined by nonlinear susceptibilities of plasma. The spectral distribution of field fluctuations is derived with the Langmuir oscillation frequency nonlinear shift taken into account. It is shown that a stationary turbulent state of plasma with the fluctuational Langmuir oscillation level much greater than the thermal one is possible. (auth)

9859 (KHFTI-72-24) INTERACTION OF FINITE-AMPLITUDE WAVES WITH A PLASMA. Shapiro, V. D.; Shevchenko, V. I. (Akademiya Nauk Ukrainskoi SSR, Kharkov. Fiziko Technicheskii Institut). 1972. 79p. (In Russian). Dep. NTIS (U. S. Sales Only) $6.00.

Basic results concerning nonlinear theory of resonance excitation and the attenuation of plasma and monochromatic electromagnetic waves are reviewed in the literature. Various mechanisms for the instability of monochromatic waves in a plasma are examined, as well as the transition toward a "single-mode" regime which is caused by these instabilities. (tr-auth)

9860 (N-73-13704) PHYSICAL PICTURE FOR THE ANOMALOUS PROPAGATION OF ORDINARY ELECTROMAGNETIC WAVES IN A PLASMA. Fried, B. D. (California Univ., Los Angeles). Jun 1972. 11p. (NASA-CR-129673; IPPJ-130). NTIS.

It is shown that the physical mechanism for the anomalous propagation of electromagnetic waves at frequencies below the plasma frequency is due to the deflection of particle thermal motions by the wave magnetic field, leading to a density perturbation which can be large when enhanced by some resonance. In presence of an external magnetic field, cyclotron resonance provides the enhancement of ordinary waves. A wave-particle resonance gives rise to anomalous propagation if the velocity distribution is anisotropic with respect to the wave vector, which allows slow electromagnetic waves, with phase velocity less than the velocity of light. (auth)

9861 (N-73-16686) NONLINEAR WAVE INTERACTION IN A PLASMA COLUMN. Larsen, J. M. (Stanford Univ., Calif. Inst. for Plasma Research). Oct 1972. Contract N00014-67-A-0112-0044. 174p. (NASA-CR-130350; SU-IPR-493). NTIS.

Two particular cases of nonlinear wave interaction in a plasma column were investigated. The frequencies of the waves were on the order of magnitude of the electron plasma frequency, and ion motion was neglected. The nonlinear coupling of slow waves on a plasma column was studied by means of cold plasma theory, and the case of a plasma column surrounded by an infinite dielectric in the absence of a magnetic field was also examined. Nonlinear scattering from a plasma column in an electromagnetic field having its magnetic field parallel to the axis of the column was investigated. Some experimental results on mode conversion in the presence of loss are presented along with some observations of nonlinear scattering. The effect of the Earth's magnetic field and of discharge symmetry on the radiation pattern are discussed. (STAR)

9862 (N-73-16693) THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE LINEAR AND NONLINEAR IMPULSE RESPONSES FROM A MAGNETOPLASMA COLUMN. Grody, N. C. (National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center). Feb 1973. 72p. (NASA-TR-R-400; G-1072). NTIS.

Linear and nonlinear responses of a magnetoplasma resulting from inhomogeneity in the background plasma density are studied. The plasma response to an impulse electric field was measured and the results are compared with the theory of an inhomogeneous cold plasma. Impulse responses were recorded for the different plasma densities, static magnetic fields, and neutral pressures and generally appeared as modulated, damped oscillations. The frequency spectra of the waveforms consisted of two separated resonance peaks. For weak excitation, the results correlate with the linear theory of a cold, inhomogeneous, cylindrical magnetoplasma. The damping mechanism is identified with that of phase mixing due to inhomogeneity in plasma density. With increasing excitation voltage, the nonlinear impulse responses display stronger damping and a small increase in the frequency of oscillation. (auth)

9863 CHARACTERISTIC MODES OF ANISOTROPIC TWO-COMPONENT PLASMA. Georges, G. C.; Sakuda, Kyohei (New York University, Bronx, New York 10453). Phys. Fluids 16: No. 2, 254-258 (Feb 1973).

A convenient formulation is presented for the numerical calculation of the complete set of characteristic modes in a two-component, fluid-model, warm, unbounded, fully ionized, and anisotropic plasma. The anisotropy in this analysis is due to a static background magnetic field. Quantitative plots of the dispersion relations and field polarizations

are presented for various modes of the system using an assumed set of typical plasma parameters. An interesting property of the hybrid low-frequency ion mode is shown to display a critical dependence on the angle between the wave propagation vector and the background magnetic field as this angle is varied near 90°. (auth)

9864 STRONG SHOCKS, SNOWPLOWS, AND MAGNETIC PISTONS. Taussig, R. T.; Chen, Y. G.; Gross, R. A. (Columbia University, New York, New York 10027). Phys. Fluids 16: No. 2, 212-216 (Feb 1973).

A comparison is made between experimentally-observed high-speed transverse shock wave data and theoretical snowplow predictions. When high voltages are employed, the snowplow model is found to be inadequate during the early time of propagation. Particle dynamics corresponding to high voltage initial conditions are examined and when an initial E×B drift is incorporated in the snowplow model, good agreement with experimental observations is achieved. Some additional observations of the experiments are briefly described. (auth)

9865 DENSITY-STEP-EXCITED ION ACOUSTIC SOLITONS. Cohn, D. B.; MacKenzie, K. R. (Department of Physics, University of California, Los Angeles, California 90024). Phys. Rev. Lett. 30: No. 7, 258-261 (12 Feb 1973).

Highly nonlinear ion acoustic solitons are produced by the superposition of a $15\lambda_D$-wide photoionized plasma slab on a dc background. The Mach number increases with the initial step ratio R up to $M \simeq 1.95$ for $R \simeq 10$. Above $M \simeq 1.8$, $R \simeq 6$, however, the profiles diffuse rapidly as they propagate. For Mach numbers $M^* 1.8$, a linear interaction is observed in the collision of two solitons traveling in opposite directions, whereas two solitons moving in the same direction exhibit a nonlinear interaction. (auth)

9866 BREAKING AND TURBULENT TRANSITION IN ION ACOUSTIC WAVES. Judice, C. N. (Bell Laboratories, Whippany, New Jersey 07981); Decker, J. F.; Stern, R. A. Phys. Rev. Lett. 30: No. 7, 267-270 (12 Feb 1973).

New wave-particle processes determining the evolution of large-amplitude, low-frequency ion waves have been observed in numerical and laboratory experiments. (auth)

9867 THE MATHEMATICAL PROBLEM OF REFLECTION SOLVED BY AN EXTENSION OF THE WKB METHOD. Chakraborty, B. (Department of Mathematics, Jadavpur University, Calcutta-32, India). J. Math. Phys. (N.Y.) 14: No. 2, 188-190 (Feb 1973).

Starting with two first order linear differential equations having slowly varying coefficients and mutually connected by the dependent variables, the reflection problem is solved approximately as in the cases of electromagnetic and acoustic waves. An extension of the WKB method is developed and applied to study this problem up to any higher order of accuracy one requires. The solution of the second order differential equation in normal form by the extended WKB method is used to find the characteristics of propagation at a point of discontinuity of higher order derivative of the parameter. (auth)

9868 PROPERTIES OF WAVES DEFINED BY THE DISPERSION RELATIONS $D(k,\omega) = 1 - (\omega_p^2/\omega^2) + (k_\beta^2/k^2) = 0$. Lonngren, K. E. (Univ. of Iowa, Iowa City); Landt, D. L.; Hsuan, H. C. S.; Burde, C. M.; Alexeff, I. pp 667-704 of Physics of Ionized Gases, 1972. Kurepa, M. V. (ed.). Belgrade; Inst. of Physics (1972).

From 6th Yugoslav symposium on physics of ionized gases; Split, Yugoslavia (16 Jul 1972). See CONF-720729-.

A generalization is made of the properties of plasma waves defined by the subject dispersion relations. An experimental simulation is made of the properties using a transmission line with passive inductors and capacitors. Four basic properties are focused on: dispersion curve, dispersion of a sine-wave burst, wave response of a "δ function" stimulus, and reflection of the wave. Relevant experiments on ion acoustic waves and bounded electron plasma waves in cold plasmas (Trivelpiece-Gould mode) are described. (35 figures, 29 references) (DLC)

9869 INTERPRETATION OF ELECTRON WAVE PROPAGATION USING LINEAR KINETIC THEORY. Buzzi, J. M. (Ecole Polytechnique, Paris). J. Phys. (Paris); 34: No. 1, 13-17 (Jan 1973). (In French).

A systematic numerical study of the problem of forced oscillations of a Maxwellian electron plasma demonstrated that experiments recently published concerning the propagation of electron waves in an infinite plasma below ω_{pe} cannot be explained without reconsidering the Maxwellian character of the electron distribution function or the classical excitation models. (FR)

9870 ELECTROMAGNETIC WAVE INSTABILITY IN A COLD ELECTRON-ION PLASMA. Seshadri, S. R. (Department of Electrical Engineering, The University of Wisconsin, Madison, Wisconsin 53706). Phys. Fluids 16: No. 2, 334-337 (Feb 1973).

The instability of an electromagnetic wave propagating obliquely to the streaming electrons in an electron-ion plasma is discussed. The maximum growth rate is found to be essentially the same for all stream directions other than normal to the wave vector. (auth)

9871 WHISTLER WAVES IN A THERMAL SIMULATION PLASMA. Gitomer, S. J. (University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico). Phys. Fluids 16: No. 2, 337-339 (Feb 1973).

Small amplitude whistler waves with $\vec{K} \| \vec{B}$ are studied using numerical simulation. The dispersive properties of these waves agree with linear theory. Nonlinear wave behavior due to magnetic trapping has been observed. The trapping time is in agreement with the Palmadesso and Schmidt theory. (auth)

9872 MAGNETOHYDRODYNAMIC SHOCK STRUCTURE IN STRONG TRANSVERSE MAGNETIC FIELDS. Taussig, Robert T. (Columbia University, New York, New York). Phys. Fluids 16: No. 3, 384-392 (Mar 1973).

Collision-dominated transverse magnetohydrodynamic shock structure is examined for the case where the magnetic fields are strong enough to make the plasma transport properties anisotropic. Different electron and ion temperatures are assumed. A singular perturbation approach is taken to obtain an analytic description of the steady shock structure. For very high Mach numbers (i.e., $u_s > a_1$, upstream sound speed) the shock width is given by $\Delta_s \simeq 2\times10^{-2}(u_s^4/n_1)[1 - 3/2(\gamma+1/\gamma-1)(b_1^2/u_s^2)]$ (m) in hydrogen where u_s, n_1, b_1, and γ are the shock speed, upstream number density, Alfvén speed, and ratio of specific heats, respectively, and where $(u_s/b_1)^2 * 12$ has been assumed. This shock width is at least an order of magnitude less than shock widths calculated at the same shock speeds with isotropic dissipation coefficients. The results agree reasonably well with previous computer simulations and experimental data. (auth)

9873 POLARIZATION OF NONLINEARLY GENERATED HARMONIC FOR OBLIQUE PROPAGATION. Boyd, T. J. M.; Fidone, I. (University of Wales, University College of North Wales, Bangor, Caernaronshire, North Wales, United Kingdom). Phys. Fluids 16: No. 3, 427-430 (Mar 1973).

Measurement of the polarization of harmonic radiation generated in a plasma by an incident extraordinary wave has recently been proposed as a means of directly determining the direction of magnetic field at the point of generation. The method demands a precise knowledge of the direction of the electric field of the harmonic at the region of generation. The effect of oblique propagation of the primary wave on the direction of the electric field of the harmonic is examined. (auth)

9874 ELECTRON CYCLOTRON DAMPING OF BERNSTEIN WAVES IN PLASMAS. Sugaya, R.; Sugawa, M.; Nomoto, H. (Ehime Univ., Matsuyama, Japan). Phys. Lett.; 44A: No. 2, 135-136(21 May 1973).

Experimental results are presented which show the electron cyclotron damping of the electrostatic cyclotron harmonic waves (Bernstein waves) propagating obliquely to the static magnetic field. (auth)

9875 ELECTRON TRAPPING IN ION SOUND WAVES IN TURBULENT PLASMA. Gratzl, H. (Univ., Innsbruck). Physica; 64: No. 3, 608-612(15 Mar 1973).

Electrons can be trapped by weakly turbulent ion sound waves. It is shown that the well-trapped electrons interact with the ion sound waves in a different manner from the untrapped electrons. A nonlinear term is obtained in the one-dimensional kinetic equations which is proportional to field amplitudes, not to field amplitudes squared. (auth)

9876 INFLUENCE OF SURFACE ABSORPTION ON CYCLOTRON OSCILLATIONS IN BOUNDED SYSTEMS. Nekrasov, A. K.; Timofeev, A. V. (Inst. of Atomic Energy, Moscow). Nucl. Fusion; 13: No. 2, 239-246(Mar 1973).

It is shown that, in a plasma with a sharp boundary, surface absorption leads to a buildup of cyclotron oscillations with negative energy. As a result, the instability region expands. A detailed analysis is made of the processes giving rise to surface absorption. By employing the concept of modulated beams (Van Kampen waves) it is possible to construct a clear picture of the phenomenon, which is compared with other processes in inhomogeneous systems leading to an exchange of energy between oscillations and plasma particles (cyclotron and Cherenkov resonance). (auth)

9877 SMALL-AMPLITUDE HYDROMAGNETIC WAVES FOR A PLASMA WITH A GENERALIZED POLYTROPE LAW. Abraham-Shrauner, B. (Washington Univ., St. Louis). Plasma Phys.; 15: No. 5, 365-385(May 1973).

A generalized set of hydromagnetic fluid equations is proposed for a fully ionized plasma with tensor pressure. Each of the two

components of the diagonalized pressure tensor obeys a polytrope law, where the pressure is proportional to a power of the mass density and magnitude of the magnetic field. The normal phase speeds are calculated for the Alfven and magneto-acoustic modes for infinitesimal waves. (auth)

9878 ION WAVE DISPERSION IN THE PRESENCE OF A FINITE-AMPLITUDE ELECTRON-PLASMA WAVE. Arunasalam, V. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08540). J. Appl. Phys. 44: No. 4, 1934-1935 (Apr 1973).

It is shown that in the presence of a large-amplitude finite-wave-number electron-plasma wave, the ion waves (of frequency ω and wave number k) do not satisfy an acoustic-type dispersion relation (i.e., ω is not proportional to k). (auth)

9879 COMMENTS ON "CRITIQUE OF ELECTROMAGNETIC TURBULENT-PLASMA SCATTERING THEORIES" BY D. S. BUGNOLO. Salat, A. (Max-Planck Institut für Plasmaphysik, 8046 Garching b. München, West Germany). Phys. Rev. A 7: No. 4, 1441-1441 (Apr 1973).

In a recent paper Bugnolo suggested that first-order smoothing theory describing wave propagation in media with random fluctuations of the refractive index should not be used for wave numbers larger than the correlation length. This suggestion is shown to be incorrect. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 8763, 8793, 9269, and 9546.

9880 (AD-751588) X-RAY CROSS SECTION COMPILATION FROM 0.1 keV to 1 MeV. Final Report. Briggs, E. A.; Veigele, W. J. (Kaman Sciences Corp., Colorado Springs, Colo.). 31 Aug 1972. Contract DASA01-70-C-0126. 68p. (DNA-2433-F (Suppl.)). NTIS.

A search of the literature was made for the period from 1920 through June 1972, to obtain experimental x-ray cross sections for the elements in the energy range from 0.1 keV to 1 MeV. Total attenuation and photoelectric absorption data were evaluated and found not to be at variance with values reported in the compilation in the final report of this study. New experimental scattering data, along with earlier compiled experimental scattering data, were compared with theoretical values used in the compilation. Data are too scarce and errors are too large to evaluate the theoretical values unequivocally. Low energy theory was explored to determine whether changes in potential, or inclusion of relativistic or correlation effects could significantly improve calculated low energy cross sections. It was concluded that correlation effects would be most important. (auth) (NTIS)

9881 (LA-5180-C, pp 60-74) THEORETICAL ASPECTS OF RADIATION DOSIMETRY. Caswell, R. S.; Berger, M. J. (National Bureau of Standards, Washington, DC). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2-5, 1972, Los Alamos Scientific Laboratory, New Mexico.

An attempt is made here to compare systematically measured absorbed dose distributions and corresponding calculations in order to obtain a picture of the state of depth dose information. (MHR)

9882 (LA-5180-C, pp 88-92) PRACTICAL DOSIMETRY: HIGH L.E.T. RADIATION. Almond, P. R. (M. D. Anderson Hospital, Houston, TX). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2-5, 1972, Los Alamos Scientific Laboratory, New Mexico.

The following topics are covered: source or accelerator selection, calibration, beam characteristics, treatment planning, in vivo dosimetry, data processing, and precision required. (MHR)

9883 (LA-5180-C, pp 93-96) RADIATION QUALITY AND ITS BIOMEDICAL IMPLICATIONS. Rossi, H. H. (Columbia Univ., New York). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2-5, 1972, Los Alamos Scientific Laboratory, New Mexico.

It appears that radiation quality is related to differences in the pattern of energy deposition on a microscopic scale. Since one is dealing with a pattern rather than a single number, the situation is quite complex, and it has been commonly dealt with by approximations that are used not only to specify radiation quality but also its biological consequences. Thus, the widely accepted view is that radiation quality can be expressed in terms of LET, and that the RBE and the OER (oxygen enhancement ratio) can be related to LET. This formulation contains a number of explicit and implicit simplifications, and they are identified here and their acceptability is radiotherapy commented on. (MHR)

9884 (LA-5180-C, pp 120-125) RADIOBIOLOGICAL DOSE EFFECT RELATIONS FOR RADIATION CHARACTERIZED BY A WIDE SPECTRUM OF LET; IMPLICATIONS FOR THEIR APPLICATION IN RADIOTHERAPY. Barendsen, G. W. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Mar 1973.

From conference on particle accelerators in radiation therapy; Los Alamos, New Mexico, USA (2 Oct 1972).

In conference on particle accelerators in radiation therapy, October 2-5, 1972, Los Alamos Scientific Laboratory, New Mexico.

A brief discussion of dose-response curves of cells, tumors, and normal tissues to neutrons and x-rays and their importance for the evaluation of possible radiotherapeutical advantages of high-LET radiations is presented, followed by an outline of the type of studies which might be carried out on clinical models. (MHR)

9885 (NBS-TN-748) ADJOINT GAMMA-RAY MOMENTS COMPUTER CODE, ADJMOM-I. Simmons, G. L. (National Bureau of Standards, Washington, D. C. Center for Radiation Research). Feb 1973. 23p. GPO $0.20.

A computer code is discussed for generating spatial-angular moments of the adjoint gamma-ray flux in an infinite medium. The equation for the flux moments is given, and techniques used for the solution are described. Details of the input data and a sample problem are also supplied. (auth)

9886 (ORNL-4869) SPAR, A FORTRAN PROGRAM FOR COMPUTING STOPPING POWERS AND RANGES FOR MUONS, CHARGED PIONS, PROTONS, AND HEAVY IONS. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 35p. Dep. NTIS $4.00.

SPAR is a FORTRAN IV program that computes the stopping powers and ranges for muons, pions, protons, and heavy ions in any nongaseous medium at energies from zero to several hundred GeV. The method of calculation and the input required are described, and computed stopping powers and ranges for various particles slowing down in water and in tissue are given. (auth)

9887 (ORNL-TM-3809) SWANLAKE, A COMPUTER CODE UTILIZING ANISN RADIATION TRANSPORT CALCULATIONS FOR CROSS SECTION SENSITIVITY ANALYSIS. Bartine, D. E.; Mynatt, F. R.; Oblow, E. M. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 93p. Dep. NTIS $6.75.

SWANLAKE calculates the sensitivity of a result (such as a dose or reaction rate) obtained from a one-dimensional discrete ordinates solution of the Boltzmann transport equation to the cross sections used in the calculation. This manual presents a brief discussion of the sensitivity function and the method used for its calculation, detailed instructions concerning the required input data, and a description of the code output. As an aid to the prospective user, the input and output of a sample problem are included, along with an interpretation of the results. A derivation of the sensitivity function and a listing of computing time and core requirements for several problems are included. (auth)

9888 (ORNL-TM-4140) ESTIMATION TECHNIQUE FOR MONTE CARLO CALCULATIONS OF DOSE FROM AN INTERNAL SOURCE OF PHOTONS. Warner, G. G. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

Buildup factors and Monte Carlo techniques have been used to calculate specific absorbed fractions of photon energy in a human body following radionuclide administration. Difficulties are encountered when the distance between the selected source point and the selected target point is greater than 40 mean free path lengths or is quite small. Estimation techniques have been devised to handle these difficulties. (auth)

9889 MUON SCATTERING DISTRIBUTION. Crookes, J. N.; Rastin, B. C. (Univ. of Nottingham, Eng.). Nucl. Instrum. Methods; 109: No. 2, 371-373 (1973).

The derivation of the mean square angle of scattering for muons in an infinitesimal layer of material was performed by numerical integration of the single scattering expression (N. F. Mott, Proc. Roy. Soc., A124: 425 (1929)) after correction for the effect of the finite size of the nucleus as well as screening of the Coulomb field of the nucleus by the orbital electrons. These results were expressed in terms of the standard deviation given by Rossi and Greisen for different values of momenta. The effect on the scattering distribution of energy loss by the incident particle when passing through the absorber was also studied using Monte Carlo techniques, and these results were compared with the work of Eyges, who utilized the original Rossi and Greisen expression for scattering in a thin layer of material. (4 figures, 1 table) (auth)

9890 BIOPHYSICAL PROPERTIES OF 3.9-GeV NITROGEN IONS. I. Dosimetry. Gross, W.; Colvett, R. D. (Columbia Univ., New York). Radiat. Res.; 54: No. 1, 3-11 (Apr 1973).

The dosimetry required for the irradiation of biological material with 3.9-GeV nitrogen ions from the Princeton Particle Accelerator was accomplished using disk shaped tissue equivalent ionization chambers. A complete depth dose curve obtained in a water and lucite phantom shows a broad entrance plateau followed by a fairly rapid rise to the Bragg peak where the dose is about four times the entrance value. Beyond the peak the dose falls rapidly to about 15% of the entrance value and thereafter decreases slowly with depth. The variation in dose across the beam was also measured for a reasonably well focused and for a defocused beam. The method of determining the dose to biological material

of nonnegligible thickness is described, and a discussion of the effect of dose variation through the specimen is given. (auth)

9891 BIOPHYSICAL PROPERTIES OF 3.9-GeV NITROGEN IONS. II. Microdosimetry. Rodgers, R. C.; Dicello, J. F.; Gross, W. (Columbia Univ., New York). AT-(11-1)-3243. Radiat. Res.; 54: No. 1, 12-23(Apr 1973).

The distributions in lineal energy of the events produced by 3.9-GeV nitrogen ions incident on a phantom were measured at several depths with both walled and wall-less proportional counters. Upstream from the Bragg peak, the distributions are narrow, reflecting the almost monoenergetic character of the radiation, while beyond the peak the distributions are broad. The dose mean lineal energy increases from about 20 keV/μm on entrance to almost 200 keV/μm at the peak, with most of the increase occurring in the last few millimeters before the peak. The distributions in LET calculated from the data are compared to corresponding distributions for 14.6-MeV neutrons and 90-MeV π^- mesons and show that at the Bragg peak a much higher proportion of the nitrogen ion dose is delivered at LET values above 100 keV/μm than by either of the other radiations. The wall effect is found to increase the measured dose mean lineal energy by about 25% in the upstream region, but it drops to about 10% at 3 mm from the Bragg peak. (auth)

9892 RESHENIE METODOM MONTE-KARLO ZADACH PERENOSA BYSTRYKH ELEKTRONOV V VESHCHESTVE. (Monte Carlo Solution to the Problem of the Passage of Fast Electrons Through Matter). Akkerman, A. F.; Nikitushev, Yu. M.; Botvin, V. A. Alma-Ata, USSR; Izdatel'stvo Nauka Kazakhskoi SSR (1972). 164p.

The treatment of theoretical and experimental data on electron-atom interactions is explained in detail, and the organization of algorithms for such treatment is discussed. Typical computer programs are outlined, and sample calculations using them are presented for eight elements and substances with atomic numbers from 3.3 to 82 in a broad range of initial energies, from 0.4 to 6.0 MeV, and for incident angles from 0 to 81°. Reliable interpolation is thus possible for applying the results obtained to any given element. (tr-auth)

9893 CHANGE IN THE ENERGY SPECTRA OF FISSION PRODUCTS OF ^{235}U DURING THEIR PASSAGE THROUGH AIR, N_2, CH_4, AND Ar. Kashukeev, N. T.; Kalinkova, N. I.; Chikov, N. F.; Toshkov, S. A. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 1, 47-50(1973). (In Russian).

The deceleration of ^{235}U fission products in air, N_2, CH_4, and Ar was investigated. The target of ^{235}U and semiconductor detectors were placed in a chamber, which was evacuated and then filled with the gas under study (1 atmosphere, 20°C) before bombarding the target with thermal neutrons. The experimentally determined energy spectra were compared with the theoretical curves obtained by the theory of J. Lindhard and M. Scharff (1963), with about 15 to 20% discrepancy. Good agreement with other experimentalists was obtained in the case of N_2 and air. (KSW)

9894 UNIFIED TREATMENT OF SECONDARY ELECTRON EMISSION FROM COPPER USING A MONTE CARLO METHOD. Ganachaud, J. P.; Cailler, M. (Ecole Nationale Superieure de Mecanique, Nantes, France). J. Phys. (Paris); 34: No. 1, 91-98 (Jan 1973). (In French).

A secondary electron emission theory is presented which provides a unified treatment for both the penetration and backscattering of primary electrons and also for the production and transport of excited secondary electrons in the metal. The theory utilizes a Monte Carlo method. It is applied to copper exposed to low energy primary electrons and gives a satisfactory explanation of the energy distribution of the secondary electrons emitted. It is somewhat difficult to make comparisons with existing measurements as considerable disagreement between such measurements occurs. The angular models adopted to describe the elastic and inelastic collisions and the use of data on the energy loss characteristics enable very reasonable values for the secondary electron yield to be determined. In addition, the dissipation of energy inside the metal was studied as a function of the energy of the primary beam. (France)

9895 CALCULATIONS OF ABSOLUTE DEPTH-DOSES AND DOSE CONVERSION FACTORS FOR ^{60}Co RADIATION IN WATER. Eisenlohr, H. H.; Abedin-Zadeh, R. (International Atomic Energy Agency, Vienna). pp 59-65 of National and International Radiation Dose Intercomparisons. Vienna; International Atomic Energy Agency (1973).

From Panel on national and international radiation dose intercomparisons; Vienna, Austria (13 Dec 1971). See STI/PUB-338; CONF-711225-.

Absolute depth-doses in water for ^{60}Co gamma irradiation are calculated for different dimensions of circular cross sections. The approximation used takes into account Compton electrons of the first and second generation. For the Compton electrons of the second generation a simplified assumption was used concerning their angular distribution. The dose conversion factors f and g, and the water-air ratio were calculated for water as the ratio of the corresponding depth-doses. The results obtained are in good agreement with the recommended values. (auth)

9896 MONTE CARLO METHOD FOR RADIATION TRANSPORT CALCULATIONS. Razani, A. (Pahlavi Univ., Shiraz, Iran). J. Nucl. Sci. Technol. (Tokyo); 9: No. 9, 551-554(Sep 1972).

A probabilistic model for radiation transport calculation is presented based on the assumption that the motion of particles can be sampled at predetermined points. Due to the fixed sampling points, the directions of motion of particles are discrete however the energy of particles can be followed continuously. More specifically the transport medium is considered to be filled with cubic lattice and sampling is made at the corner of the cubes. A brief description of Boltzmann transport equation and its connection to the mathematical development of this model is clearly shown. The model and its development is general and has application in many fields associated with radiation transport calculation. (auth)

9897 AUGER ELECTRON DOSIMETRY. Wrenn, M. E.; Howells, G. P.; Hairr, L. M.; Paschoa, A. S. (New York Univ., NY). Health Phys.; 24: No. 6, 645-653(Jun 1973).

Calculations of radiation dose from nuclides which decay by electron capture were conventionally performed by assuming that the resultant x-rays are absorbed in a "beta-like" fashion. However, Auger electron emission is more probable than x-ray emission for most elements of biological interest. The energy associated with the Auger process is conventionally included with the x-ray energy in calculations of dose ($\Delta E/\Delta M$). Since the range of an Auger electron is many times smaller than the mean free path of the equivalent x-ray, conventional calculations of dose may result in grossly inaccurate estimates whenever the dimensions of the biological object of interest is small compared to the mean free path of the x-ray. Since many elements are known to localize in subcellular structures (e.g. iron in ferritin aggregates) accurate dose calculations for electron capture nuclides are of great biological interest. Irradiation of biological systems with electron capture nuclides should provide a powerful tool to investigate radiation effects, and most particularly the adequacy of our present concepts of dose at the cellular and subcellular levels. (auth)

9898 ESCAPE LENGTH OF AUGER ELECTRONICS. Tarng, M. L.; Wehner, G. K. (Physical Electronics Laboratory, Department of Electrical Engineering, University of Minnesota, Minneapolis, Minnesota 55455). J. Appl. Phys. 44: No. 4, 1534-1540 (Apr 1973).

Sputter deposition of Mo atoms on W substrates (and vice versa) was shown to form uniform overlayers. Such overlayers are ideally suited for studies of the escape length of Auger electrons. The results show that the escape length increases with Auger electron energy as expected. In both Mo and W the escape length of 48-eV Auger electrons is about 5 Å. For 1736-eV Auger electrons it increases to 24 Å in Mo and 17 Å in W. For a Mo overlayer on W, the Mo signal can reach an intensity 1.2 times that of the bulb Mo signal due to the higher backscattering coefficient of W. For a W overlayer on Mo, a corresponding reduction in the W signal compared to bulk W, i.e., an increase in the apparent escape depth was observed. With a model in which the backscattering effect is incorporated, one obtains satisfactory agreement with the experimental results. In addition the result indicates that while high-energy Auger peaks are generated by the primary beam alone, a substantial fraction of observed low-energy Auger electrons are generated by backscattered electrons. For the case of the Mo (120-eV) Auger signal with 3-keV primary beam energy, this fraction amounts to approximately 40%. (auth)

Radiation Protection Standards

Refer also to abstract 8244.

9899 (JPRS-58071) SCIENTIFIC AFFAIRS NO. 298. Translations on Eastern Europe Scientific Affairs No. 298. 26 Jan 1973. 103p. NTIS.

The translations included three papers. A separate abstract was prepared for one paper. Other papers were outside the scope of NSA. (JFP)

For an abstract of an individual paper see: 9900.

9900 (JPRS-58071, pp 1-91) MINISTRY OF HEALTH RADIATION SAFETY STANDARDS. Jan 1973. Translated from Durzh. Vestn.; No. 94, 6-16(1972).

The topics discussed cover the basic concepts, the range of

application of the standards, categories of irradiated persons and groups of critical organs, maximum permissible doses, personnel irradiation, irradiation of individuals in the general population, and irradiation of the entire population. (JFP)

Radiation Source Calibration and Standardization

9901 (AD-754756) NOMOGRAPHS FOR DETERMINING THE THICKNESS OF RADIATION SHIELDS FOR TWO-PARTICLE RADIATION SOURCE. Simons, D. G. (Naval Ordnance Lab., White Oak, MD). 31 Oct 1972. 20p. (NOLTR-72-260). NTIS.

A description of two nomographs, one linear and one circular, is given. These nomographs can be used to determine the thickness of two component radiation shields for sources which emit two different types of particles. Emphasis is placed on the specific case in which the two particles are neutrons and gamma rays and the absorbers are polyethylene and lead. (auth) (NTIS)

9902 (AD-754768) RADIATION TRANSPORT METHODS FOR DETERMINING THE RADIATION RESPONSE FROM GENERAL ANISOTROPIC SOURCES. Final Report, 15 February 1971–14 February 1972. Woolson, W. A.; Coleman, W. A. (Science Applications, Inc., La Jolla, Calif. (USA)). Jan 1973. Contract DASA01-71-C-0033. 78p. (SAI-72-539-LJ; DNA-2917-F). NTIS.

Two radiation transport calculational techniques were developed which permit the study of radiation fields resulting from a broad class of source anisotropies important in weapon effects without having to perform transport calculations for each specific angle-energy dependent source. One method, limited to homogeneous air, uses adjoint one-dimensional discrete ordinates to calculate the importance of a particle's contribution to the fluence at various field points as a function of source emission angle. The radiation field is calculated, using this method, by integrating the product of the source function and the importance function over the 4 pi solid angle. The other, more general, method which can be used for air-over-ground, variable air density configurations and can include time and angular dependent flux, employs Monte Carlo to calculate moments of the fluence with respect to the polar angle of emission from the source. The coefficients of the power series expansion of a particular source anisotropy can then be folded with the moments to give the flux field for that source. (auth) (NTIS)

Shielding Calculations and Experiments

Refer also to abstracts 9517 and 10010.

9903 (AD-754767) MULTIGROUP ANALYSIS OF NEUTRON AND SECONDARY γ RAY TRANSPORT IN CONCRETE. Final Report, 1 January 1970–15 May 1971. Scott, W. H. Jr.; Dupree, S. A.; Groce, D. E.; Huffman, D. L.; Profio, E. A. (Science Applications, Inc., La Jolla, Calif. (USA)). 1 Oct 1972. Contract DASA01-70-C-0053. 205p. (SAI-71-553-LJ; DNA-2994-F). NTIS.

Several calculations were compared with a Gulf General Atomic concrete experiment to evaluate multigroup calculational techniques of neutron and secondary γ transport in concrete, including the effects of cross sections. Discrete ordinates calculations were performed with the DTF, DOT, and TDA codes. These results were compared with experiment and with two-dimensional, time-dependent Monte Carlo calculations with MORSE, including effects of lead shielding around the NE 213 detector. The concrete composition included oxygen, hydrogen, calcium, and silicon for transport, plus trace amounts of potassium, aluminum, and iron for γ production. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 9240, 9439, and 9790.

9904 (CNRS-CPT-72-P-499) EXPLICIT-TIME DEPENDENT INVARIANCE PROPERTIES OF QUANTUM MECHANICAL SYSTEMS. Burdet, G.; Perrin, M.; Sorba, P. (Centre National de la Recherche Scientifique, Marseilles (France). Centre de Physique Theorique). Dec 1972. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

Some properties of the structure of explicit time dependent invariance algebra are stated. The concept of split extension algebra is used to embody a given invariance algebra of a quantum mechanical system, a realization of which is known in terms of some variables, in a richer invariance algebra expressed in terms of the same variables. The procedure is applied to a free system of particles to obtain the invariance under the Schroedinger algebra, a larger invariance algebra which can uniquely describe a free system of noninteracting particles is constructed. (France)

9905 (JINR-P2-7052) SIMPLE PROOF OF THE EXTREMUM PROPERTY OF NODELESS SOLUTION OF SCHROEDINGER EQUATION. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 5p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A simple proof of the extremum property of the nodeless solution of Schroedinger equation is given. (auth)

9906 DETECTION AND "EMISSION" PROCESSES OF QUANTUM PARTICLES IN A "CHAOTIC STATE". Benard, Christine; Macchi, Odile (Laboratoire d'Etudes des Phénomènes Aléatoires, Université de Paris-Sud, Bâtiment 210 - 91 Orsay, France). J. Math. Phys. (N.Y.) 14: No. 2, 155-167 (Feb 1973).

We study the statistical properties of a chaotic beam of quantum particles (bosons or fermions) by using wavepacket formalism, which allows us to deal with bosons and fermions in a very symmetrical way. Our study is based on the definition and analysis of two different stochastic point processes consisting, respectively, of the "emission" time instants and detection time instants (or positions in a space) of the particles of the beam. The two processes are shown to be identical in the chaotic boson case and in the chaotic fermion case, respectively. The symmetry between the well-known results concerning the photon detection process and the new results concerning the fermion detection process is pointed out. And finally it is noted that in the chaotic case the bunching (or antibunching) effect is present already in the "emission" of the particles. (auth)

9907 EXACT BOUND STATES OF SOME N-BODY SYSTEMS WITH TWO- AND THREE-BODY FORCES. Calogero, F. (Istituto di Fisica dell'Università di Roma, Istituto Nazionale di Fisica Nucleare, Sezione di Roma, Rome, Italy); Marchioro, C. J. Math. Phys. (N.Y.) 14: No. 2, 182-184 (Feb 1973).

The exact wavefunctions and the corresponding binding energies are exhibited, for some N-body systems with long-range two-body and three-body forces. These results may also be used to obtain upper and lower bounds for the binding energies of certain many-body systems with two-body forces only. (auth)

9908 NTH RANK TENSOR REPRESENTATIONS OF U(N) SYMMETRY ADAPTED TO SUBGROUPS OF THE SYMMETRIC GROUP S_N. Sullivan, John J. (Physics Department, Southern Illinois University, Carbondale, Illinois 62901). J. Math. Phys. (N.Y.) 14: No. 3, 387-395 (Mar 1973).

Representations of the symmetric group S_N symmetry adapted to subgroup sequences $S_N \nearrow \otimes S_{N_1} \searrow \otimes S_{1N_1}$ / $S_N \searrow \otimes S_{N'} \nearrow \otimes S_{1N'}$ are considered using double-coset decomposition. The matrix elements of the double-coset representatives are given and their group theoretical properties are discussed. The matrix elements are identified with the recoupling transformations of the unitary group by considering the tensor representations of the latter. The orthogonality and completeness relations of the symmetric group expressed in terms of double-coset representative matrix elements are used to establish general relations that must be satisfied by the coupling coefficients of the unitary group. (auth)

9909 DIFFERENTIAL EQUATIONS FOR ONE-LOOP GENERALIZED FEYNMAN INTEGRALS. Barucchi, G. (Istituto di Fisica dell'Università, Torino, Italy); Ponzano, G. J. Math. Phys. (N.Y.) 14: No. 3, 396-401 (Mar 1973).

A system of (2^n-1) first-order linear homogeneous differential equations in each variable is derived for the generalized (with Speer λ parameters) Feynman integrals corresponding to the one-loop graph with N external lines. This system of differential equations is shown to belong to the class studied by Lappo-Danilevsky. A connection with the matrix representation of the monodromy group in all variables is pointed out. (auth)

9910 BOSON REALIZATION OF THE UNITARY SYMPLECTIC GROUP. Quesne, C. (Physique Théorique et Mathématique, Université Libre de Bruxelles, Brussels, Belgium). J. Math. Phys. (N.Y.) 14: No. 3, 366-372 (Mar 1973).

A realization of the Lie algebra of the unitary symplectic group is proposed in terms of boson operators. The existence of a noncompact orthogonal group, complementary to the symplectic one, is shown. The highest weight polynomial of an irreducible representation of the latter group is constructed with the help of the former. (auth)

9911 THE APPLICATION OF REGGE SYMMETRY TO THE 9-J SYMBOL. Holman III, Wayne J. (Department of Physics and Astrophysics, University of Colorado, Boulder, Colorado 80302). J. Math. Phys. (N.Y.) 14: No. 3, 330-336 (Mar 1973).

The Regge transposition symmetry is applied to one of the six Wigner coefficients in the defining expression for the Wigner (9-j) symbol; couplings are then performed, and an expression for the (9-j) symbol is obtained which factorizes the sums of the angular momenta in two rows and their differences into different factors. (auth)

9912 ESSAYS IN PHYSICS. Volume 4. Conn, G. K. T.; Fowler, G. N. (eds.). New York; Academic Press, Inc. (1972). 168p. $5.95.

Four essays are included; an abstract was prepared for the essay on gravitation. The essay on the electromagnetic structure of nucleons was previously abstracted for NSA and appeared as 27: 13604. Two essays were not within the subject scope of NSA. (LBS)

For an abstract of an individual paper see: 9933.

9913 SOLUTION OF THE SCHRÖDINGER EQUATIONS WITH A PERIODIC PERTURBATION. Gupta, N. D. Sen (Tata Institute of Fundamental Research, Bombay-5, India). Phys. Rev. A 7: No. 3, 891-896 (Mar 1973).

The object of the paper is to obtain a perturbation expansion of the wave function which satisfies arbitrary initial conditions. For periodic perturbations, a method is developed to obtain the solution without any secular terms. It maintains the normalization condition for all times, which assures the unitarity of the transition amplitudes. (auth)

9914 A COMPUTABLE EXPANSION FOR MULTIPARTICLE PROPAGATORS. Galas, D. J. (Department of Applied Science, University of California, and U. S. Air Force, Livermore, California); Jensen, C. A.; Sahlin, H. L. J. Math. Phys. (N.Y.) 14: No. 4, 524-530 (Apr 1973).

A formulation of the propagator for a quantum system is constructed to simplify computation for multiparticle systems. The propagator is manifested in terms of any complete set on the Hilbert space of physical states of the system. In the short-time limit a particularly simple matrix expression is obtained using an energy eigenstate basis. This formulation is shown to contain all orders of perturbation theory in an approximate form. Identical particle exchange is handled in a straightforward manner in which only the number of terms, but not the complexity, of expressions is affected. The number of terms is held to manageable proportions by approximating multiple-particle exchange with repeated operations containing only two-particle exchange. Three-particle exchange is represented exactly by this approximation in the limit of infinitesimal time steps. An argument is presented that indicates that this is also true for an arbitrary particle number. (auth)

9915 GREEN'S FUNCTION FOR MARKOVIAN SYSTEMS. Thomson, J. J.; Benford, Gregory (Department of Physics, University of California, Irvine, California 92664). J. Math. Phys. (N.Y.) 14: No. 4, 531-536 (Apr 1973).

Many perturbation series solutions to stochastic differential equations suffer from secularity; that is, individual terms in the series behave as some power of an independent variable, and thus diverge as that variable goes to infinity. We derive a method of renormalizing the "free" or "unperturbed" Green's function by summing a certain class of terms and including them in the Green's function. The terms included in this class correspond to Markovian interaction with the stochastic field. The remainder of the perturbation series corresponds to non-Markovian corrections. We give a diagrammatic interpretation of the individual terms in the perturbation series. We may solve, under certain assumptions, the explicit form of the Markovian Green's function. We apply this method to plasma turbulence, and show that it produces Dupree's theory of turbulence. We derive the condition for

validity of the perturbation expansion, which is that particles are not "trapped" by the turbulent waves. (auth)

Quantum Field Theories

Refer also to abstracts 9358 and 9936.

9916 ANOMALOUS DIMENSIONS IN ONE-DIMENSIONAL QUANTUM FIELD THEORY. Parisi, G. (Laboratori Nazionali del CNEN, Frascati, Italy); Zirilli, F. J. Math. Phys. (N.Y.) 14: No. 2, 243-245 (Feb 1973).

We study the short distance behavior of the Green's functions of two operators in a soluble one-dimensional model of quantum field theory with dimensionless coupling constant. Integer power behavior does not occur. The leading terms of the Wilson expansion of two operators at short distances are determined. (auth)

9917 ON MATRIX SUPERPROPAGATORS. I. Ashmore, J.; Delbourgo, R. (Physics Department, Imperial College, London SW7 2BZ, England). J. Math. Phys. (N.Y.) 14: No. 2, 176-181 (Feb 1973).

Given the free propagator of a matrix-valued field $\phi_{\alpha\beta}$ in the form $<\phi_{\alpha\beta}(x),\ \phi_{\gamma\delta}(0)> = (1/2)(\delta_{\alpha\gamma}\ \delta_{\beta\delta}+\delta_{\alpha\delta}\delta_{\beta\gamma}-2c\delta_{\alpha\beta}\delta_{\gamma\delta})\ \Delta\ (x)$, we derive an integral representation for the matrix superpropagator for arbitrary n, and apply this to find the exponentially parametrized gravity superpropagator $<\vdash g(x)\ |^{\mu}g_{\alpha\beta}(x),\ \vdash g(0)\ |^{\nu}g_{\gamma\delta}(0)>$ with $g_{\mu\nu}(x) \equiv [\exp |\phi\ (x)]_{\mu\nu}$. Other applications are also mentioned. (auth)

9918 APPLICATIONS OF RENORMALIZATION GROUP RECURSION FORMULAS TO PROBLEMS IN CRITICAL PHENOMENA AND QUANTUM FIELD THEORY. A. Calculation of the Critical Exponent Eta. B. Wave Function Renormalization of a Scalar Field Theory in Two Space, One Time Dimensions. C. The Potts Model. Golner, G. R. Ithaca, NY; Cornell Univ. (1972). 68p. University Microfilms Order No. 73-6648.

Thesis (Ph. D.).

The extension of the applications of renormalization group recursion formulas to problems in critical phenomena and quantum field theory is considered. An extension of Wilson's renormalization group calculation of Ising model critical exponents to include calculation of the critical exponent η is presented. New recursion formulas are derived using the simplest set of consistent approximations which allow a nonzero η. They are intended to demonstrate, qualitatively, how nonzero values for η are consistent with the renormalization group approach; they do not represent systematic, quantitative improvements to Wilson's earlier calculation of the exponents ν and γ. The equations are solved both by ϵ expansion about 4 dimensions and by numerical integration in 3 dimensions. To order ϵ^2 we obtain $\eta = 0.05\epsilon^2$. Numerical results in 3 dimensions are $\eta = 0.058$, $\nu = 0.588$, $\gamma = 1.14$. Analysis of the spin–spin correlation function confirms the relation $\gamma = (2 - \eta)\nu$. An extension of Wilson's qualitative solution of the renormalization problem for the $\lambda_0\phi^6$ interacting scalar field theory in two space and one time dimensions via renormalization group techniques. Specifically, Wilson's qualitative derivation of renormalization group recursion formulas is extended to include the possibility of wave function renormalization. It is found that wave function renormalization is indeed required for the interacting theory to be finite. As a consequence of wave function renormalization, the field ϕ has an anomalous dimension, about 0.53 in mass units. Using renormalization group techniques, a continuous spin generalization of the three-component Potts model is studied. Previous numerical studies, based on high and low temperature series expansions of the partition function, have predicted, in conflict with Landau theory, that the model exhibit a second order phase transition. In agreement with Landau theory it is found that the model exhibits a first order phase transition having finite, zero field spontaneous magnetization at the transition point. Numerical results are presented for the model in three dimensions. (Diss. Abstr. Int., B)

9919 BETHE-SALPETER EQUATION: NUMERICAL EXPERIENCE WITH A HYDROGENLIKE ATOM. Gammel, J. L.; Menzel, M. T. (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Phys. Rev. A 7: No. 3, 858-866 (Mar 1973).

As a test of the accuracy of numerical techniques used in solving the Bethe-Salpeter equation, we compute the binding energy of a hydrogenlike atom including one-photon exchange only. A 5% deviation from the result predicted from the Dirac equation with a Coulomb potential is in agreement with a result which we derive analytically, $E_b = (1/4)m\alpha^2[1-(4\alpha/\pi)\ln(2/\alpha)+...]$. E_b cannot be expanded in a power series in α^2 similar to the series expansion of the Sommerfeld expression for E_b resulting from the Dirac theory. This apparently startling result is not due to a failure of quantum electrodynamics, of course, but to the fact that we have used the relativistic interaction $\gamma^{(1)}{}_{\mu}(1/k^2)\ \gamma^{(2)}{}_{\mu}$ rather than working in the Coulomb gauge as is usually done. Salpeter remarked in 1952 that doing the calculation as we have done it would result in a slowly convergent series for E_b; nevertheless the precise magnitudes involved are surprising. (auth)

9920 LOCAL HIGGS–KIBBLE TYPE THEORIES IN THE UNITARY GAUGE. Sarkar, S. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B56: No. 2, 493-506(1973).

A general formal foundation of local theories using the Higgs–Kibble mechanism is given in the unitary gauge. The general term that is added to the Lagrangian owing to the presence of a gauge group is found both when the gauge group has and has not a non-trivial unbroken subgroup. The conjecture made by Weinberg about the form of this term when there is a non-trivial unbroken subgroup is found to be false in general. However when the unbroken subgroup is Abelian the conjecture is shown to be correct. (auth)

9921 SOLUTIONS OF THIRRING'S EQUATIONS FOR UNBOUNDED FIELD OPERATORS. de Mottoni, P.; Tesei, A. (CNR, Rome). Nuovo Cim.; 15A: No. 3, 536-542(1 Jun 1973).

Thirring's equations are formulated for unbounded operator-valued functions. The existence and uniqueness of the solution is established. The result is independent of the assumption of commutation-anticommutation properties. (auth)

9922 THEORY OF RELATIVITY AND QUANTIZATION OF ACTION. Anastassov, A. H. (Univ., Sofia). Compt. Rend, Acad. Bulg. Sci.; 26: No. 1, 15-18(1973). (In French).

It is shown that relativity theory has certain possibilities for the explanation of quantum effects starting with the postulate that the action of the whole system can only acquire values which are integral multiples of Planck's constant. In the suggested model the idea of particles has only a macroscopic significance. The individual pole does not correspond to the classical idea of particle with a given moment. The concepts of observable mass, trajectory, etc. have only the sense of macroscopic averages, and for an interval of time sufficiently limited, they lose their significance. (JFP)

9923 HUGGINS-RENORMALIZED ELECTRODYNAMICS: A SYSTEM OF CHARGED PARTICLES. Hogan, P. A. (Inst. of Advanced Studies, Dublin). Lett. Nuovo Cim.; 7: No. 4, 135-138 (26 May 1973).

A system of charged particles is considered, and the four-force acting on one of them due to its own field and the field of all the others is obtained. The external field is well specified, and one would expect the corresponding four-force to be a Lorentz force. However, it is shown that this is not the case if a Huggins term is present in the electromagnetic energy–momentum tensor. (JFP)

9924 LOWER BOUND TO LIMITING FIELDS IN NONLINEAR ELECTRODYNAMICS. Soff, Gerhard; Rafelski, Johann; Greiner, Walter (Institut für Theoretische Physik der Universität Frankfurt, Frankfurt am Main, Germany). Phys. Rev. A 7: No. 3, 903-907 (Mar 1973).

In view of new high-precision experiments in atomic physics it seems necessary to reexamine nonlinear theories of electrodynamics. The precise calculation of electronic and muonic atomic energies has been used to determine the possible size of the upper limit E_{max} to the electric field strength, which has been assumed to be a parameter. This is opposed to Born's idea of a purely electromagnetic origin of the electron's mass which determines E_{max}. We find $E_{max} \geq 1.7\times10^{20}$ V/cm. (auth)

9925 HAMILTONIAN ORDERINGS AND FUNCTIONAL INTEGRALS. Mayes, I. W.; Dowker, J. S. (Department of Theoretical Physics, University, of Manchester, Manchester, England). J. Math. Phys. (N.Y.) 14: No. 4, 434-439 (Apr 1973).

The factor ordering problem is discussed using functional integrals and the nonuniqueness of the quantum Hamiltonian is more closely investigated. Systems whose Hamiltonians are quadratic in the momenta are considered in detail and the equivalence of the canonical and Lagrangian approaches is explicitly confirmed by an averaging procedure. It is important that the integrand be in an averaged form if formal manipulations such as partial integrations are to be performed. This is probably significant for perturbation calculations. (auth)

9926 EXACT NONPLANAR SOLUTIONS OF THE CLASSICAL RELATIVISTIC THREE-BODY PROBLEM. Chern, De-Ching; Havas, Peter (Department of Physics, Temple University, Philadelphia, Pennsylvania 19122). J. Math. Phys. (N.Y.) 14: No. 4, 470-478 (Apr 1973).

It was shown recetly by Havas that for a Newtonian system of three particles there exists a class of exact solutions which is nonplanar, such that the particles revolve with constant angular velocity in circular orbits in parallel planes. Such motions are possible for central forces which are arbitrary functions of the mutual separations, provided that the forces are repulsive between one pair of particles and attractive

between the two other pairs (which for Coulomb forces corresponds to two like charges and one unlike one). In this paper, it is established that such motions are possible also for relativistic three-body systems with time-symmetric electromagnetic or mesic interactions; they reduce to the Newtonian solutions in the appropriate limit. Beyond this, there also exist exact relativistic solutions with the same orbits which have no nonrelativistic counterpart. These include solutions with all electric charges of the same sign, as well as solutions with all three particles on the same side of the axis of rotation; degenerate cases include planar and nonplanar two-particle solutions and a one-particle circular solution. (auth)

Gravitation and General Relativity

Refer also to abstracts 9120 and 9132.

9927 ALGEBRAICALLY SPECIAL PERTURBATIONS OF THE SCHWARZSCHILD METRIC. Couch, W. E.; E. T. Newman (Department of Physics, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). J. Math. Phys. (N.Y.) 14: No. 2, 285-286 (Feb 1973).

Algebraically special perturbations of the Schwarzschild metric are found and expressed in a simple form. They become singular on the event horizon. (auth)

9928 SPACES ADMITTING GRAVITATIONAL FIELDS. Marathe, Kishore B. (Physics Department, St. John Fisher College, Rochester, New York 14618). J. Math. Phys. (N.Y.) 14: No. 2, 228-233 (Feb 1973).

We start with a modern version of Einstein's definition of a gravitational field. Tensors of curvature type and the curvature product of symmetric tensors are defined. The interaction tensor is defined as the curvature product of the fundamental tensor and the energy-momentum tensor. The tensor W obtained by coupling the Riemann tensor and the interaction tensor is used to obtain a characterization of gravitational fields. The linear transformation of the space of second-order differential forms, induced by W, is used to give a new definition of a gravitational field. The field equations are expressed in terms of the gravitational sectional curvature function f. Thorpe's theorem characterizing Einstein spaces is obtained as a corollary. New formulations of the field equations are used to solve the problem of classification of gravitational fields. The mathematical foundations of the theory of classification are examined and a geometric interpretation of classification is obtained by using the critical point theory on a suitable manifold. (auth)

9929 SPACE-TIMES WITH A FUTURE PROJECTIVE INFINITY. Eardley, D. (Department of Physics, University of California, Berkeley, California 94720); Sachs, R. K. J. Math. Phys. (N.Y.) 14: No. 2, 209-212 (Feb 1973).

We use a projective structure to make precise the concept of "future timelike infinity" for certain space-times. We apply our definitions to many exact and approximate solutions of the Einstein equations. Some physical restrictions are necessary. (auth)

9930 A SPINOR APPROACH TO THE GENERALIZED SINGULAR ELECTROMAGNETIC FIELD THEORY OF BEL, LAPIEDRA, AND MONTSERRAT. Zund, Joseph; Maher, William (Department of Mathematical Sciences, New Mexico State University, Las Cruces, New Mexico). J. Math. Phys. (N.Y.) 14: No. 2, 168-172 (Feb 1973).

A spinor approach to the generalized singular electromagnetic field of Bel, Lapiedra, and Montserrat is presented. We include new proofs of the basis existence theorems of the field theory using the method of spin coefficients, and interpretations of these theorems in terms of the optical scalars associated with a null geodesic congruence. We also exhibit general classes of solutions of the generalized singular electromagnetic field equations and classify them according to the optical properties of their associated null geodesic congruences. (auth)

9931 COMPATIBILITY OF STRONG GRAVITY WITH THE PION DECAY RATE. Capper, D. (Imperial Coll. of Science and Tech., London); Leibbrandt, G. Nuovo Cim.; 15A: No. 1, 91-106(1 May 1973).

With the aid of the observed $\pi \rightarrow \mu\nu$ decay time, the value of the coupling constant required in the theory of strong gravity is calculated. The result compares favourably with the value obtained from $f \rightarrow \pi^+\pi^-$ decay. (auth)

9932 RECOILLESS EMISSION AND RECEPTION OF γ-GRAVITONS IN LABORATORY AND COSMIC CONDITIONS. Alekseev, A. V.; Kopvillem, U. Kh. (Physical-Technical Inst., Kazan). Spectrosc. Lett.; 6: No. 5, 305-308(1973).

The theory of Landau and Lifshitz and Mossbauer nuclei are used to estimate the order of magnitude for graviton production. It is found that $3(10)^{23}$ excited nuclei of iridium-191 per second will radiate one γ-graviton. The superscattering method is described for detecting the graviton flow. (JFP)

9933 GRAVITATION. Thirring, W. (Univ., Vienna). pp 125-163 of Essays in Physics. Vol. 4. Conn, G. K. T. (ed.). New York; Academic Press, Inc. (1972).

An elementary discussion of theories of gravitation constructed according to the pattern of classical electrodynamics is given. The various features of gravitation discussed are: universality; weakness; thermodynamic behavior of gravitating particles; life and death of stars; gravitational radiation; the equivalence principle; strong and weak equivalence; and the Schwarzschild radius. (LBS)

9934 RATE OF A MOVING CLOCK IN GENERAL RELATIVITY. Markley, F. L. (Williams Coll., Williamstown, MA). Lett. Nuovo Cim.; 7: No. 4, 133-134(26 May 1973).

The extension to general relativity of the factor by which a clock moving with speed v runs slower than a stationary clock, where c is the speed of light in vacuum, is cast in a form more closely analogous to that equation in which the metric tensor does not appear explicitly. (JFP)

9935 SOME REMARKS ON THE KASNER SPACE-TIME. Osinovskii, M. E. (Inst. of Theoretical Physics, Kiev). Lett. Nuovo Cim.; 7: No. 2, 76-78(12 May 1973).

The Kasner space-time metric is investigated in the region $z > 0$. It is shown that a regular analytic extension of the metric through the singular hypersurface $z = 0$ is impossible. The geodesic motion in the Kasner space-time is then considered. It is suggested that the metric in the domain $z > 0$ describes a static gravitational field with plane symmetry, generated by plane distributed negative masses at $z = 0$. (LBS)

9936 NEW SOLUTION OF EINSTEIN'S UNIFIED FIELD THEORY. Buchner, K. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1708-1717(Nov 1972).

A new set of exact solutions to Einstein's unified field theory was found. It has the property that the symmetric part of the connection vanishes globally in some system of coordinates and that arbitrary initial values of the basic tensor g_{ik} can be specified at any given point (complete integrability). The components of the fundamental tensor are polynomials of degree ≤ 2 in the coordinate system under consideration. For the case of a constant electromagnetic current of length zero, these solutions yield a result different from the general theory of relativity. (auth)

9937 CONFORMAL INVARIANCE OF THE EQUATIONS OF MOTION IN CURVED SPACES. Schnirman, E.; Oliveira, C. G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Ann. Inst. Henri Poincare, Sect. A; 17: No. 4, 379-397(1972).

The conformal invariance of the classical and quantum equations of motion in curved spaces is studied. It is shown that this invariance may be obtained without considering any mass variation. This is possible with a suitable modification of the metric of the Riemannian space-time. The arc element of the new geometry depends on the values of the vector field along a trajectory leading to the point under consideration. This new formulation may be called a semi-metrical formulation, in the sense that not only the metric $g_{\mu\nu}x$ is a fundamental object, but also the vector field. (France)

9938 CONFORMALLY INVARIANT ORTHOGONAL DECOMPOSITION OF SYMMETRIC TENSORS ON RIEMANNIAN MANIFOLDS AND THE INITIAL-VALUE PROBLEM OF GENERAL RELATIVITY. York, James W. Jr. (Joseph Henry Laboratories, Princeton University, Princeton, New Jersey 08540). J. Math. Phys. (N.Y.) 14: No. 4, 456-464 (Apr 1973).

It is shown that an arbitrary symmetric tensor ψ^{ab} (or ψ_{ab}) of any weight can be covariantly decomposed on a Riemannian manifold (M,g) into a unique sum of transverse-traceless, longitudinal, and pure trace parts. The summands involve only linear operators and are mutually orthogonal in the global scalar product on (M,g). Each summand transforms separately into itself if the decomposition is carried out properly in a conformally related space $(M,\tilde{g})$. The decomposition is therefore determined by a conformal equivalence class of Riemannian manifolds. This property makes the decomposition ideally suited to the initial-value problem of general relativity, which becomes, as a result, a well-defined system of elliptic equations. Three of the four initial-value equations are linear and determine the decomposition of a symmetric tensor. The fourth equation is quasilinear and determines the conformal factor. The decomposition applied to the space of symmetric tensors on (M,g) can be written in terms of a direct sum of orthogonal linear spaces and gives a framework for treating and classifying deformations of Riemannian manifolds pertinent to the theory of gravitation and pure geometry. (auth)

9939 CLASSIFICATION OF SPACE-TIMES IN GENERAL RELATIVITY. Adler, Ronald J.; Sheffield, Charles (The American University, Washington, D.C. 20016). J. Math. Phys. (N.Y.) 14: No. 4, 465-469 (Apr 1973).

The relationship between the Petrov classification of Riemannian space-times and the Debever-Penrose principal null directions is developed in explicit algebraic terms. (auth)

9940 EXTENSION OF A COMPACT LORENTZ MANIFOLD. Miller, J. G.; Kruskal, M. D. (Program in Applied Mathematics, Princeton University, Princeton, New Jersey 08540). J. Math. Phys. (N.Y.) 14: No. 4, 484-485 (Apr 1973).

For a certain geodesically incomplete, compact Lorentz manifold T, we construct an analytic non-Hausdorff extension in which no geodesic bifurcates. The extension is geodesically incomplete, but is a maximal analytic Lorentz manifold in the sense that any further analytic extension has bifurcating geodesics. We also obtain a maximal analytic Hausdorff extension of the universal covering space of T. The latter extension is geodesically complete. (auth)

9941 GLOBAL ANALYSIS OF THE KERR-TAUB-NUT METRIC. Miller, J. G. (Program in Applied Mathematics, Princeton University, Princeton, New Jersey 08540). J. Math. Phys. (N.Y.) 14: No. 4, 486-494 (Apr 1973).

The Kerr-Taub-NUT metric is a local analytic solution of the vacuum Einstein-Maxwell equations. When the metric is expressed in Schwarzschild-like coordinates, two types of coordinate singularity are present. One occurs at certain values of the "radial" coordinate where g_{rr} becomes infinite and corresponds to bifurcate Killing horizons; the other occurs at $\theta=0,\pi$, where the determinant of the components of the metric vanishes. It is shown that for nonzero NUT parameter the fixed points of the bifurcate Killing horizons and the degeneracies at $\theta=0,\pi$ cannot all be covered in one manifold. A maximal analytic manifold is constructed which covers the degeneracies at $\theta=0,\pi$. It is non-Hausdorff but contains maximal Hausdorff subspaces, topologically $S^3\times R$, which reduce to Taub-NUT space for vanishing Kerr parameter. Kerr-Taub space can be interpreted as a closed, inhomogeneous electromagnetic-gravitational wave undergoing gravitational collapse. Another maximal analytic manifold is constructed which covers the fixed points of the bifurcate Killing horizons and the degeneracy at $\theta=0$. It is suggested that this manifold represents the superposition of the Kerr geometry and a massless source of angular momentum at $\theta=\pi$ characterized by the NUT parameter. (auth)

9942 THE DIFFERENTIABLE AND CAUSAL STRUCTURES OF SPACE-TIME. Woodhouse, N. M. J. (Department of Physics, Joseph Henry Laboratories, Princeton University, Princeton, New Jersey). J. Math. Phys. (N.Y.) 14: No. 4, 495-501 (Apr 1973).

An improved version is presented of Ehlers, Schild, and Pirani's axiomatization of the differentiable and causal structures of space-time. It is shown that, under certain physically reasonable axioms, the properties of freely falling particles and light signals define a causal and differentiable structure on space-time. Further, it is shown how the causal structure defines a conformal structure and that light signals propagate along conformal null geodesics. (auth)

REACTOR TECHNOLOGY AND REGULATION

9943 (RT/EC-(72)4) OPERATION OF NUCLEAR POWER PLANTS: STATISTICAL REMARKS. Maccazzola, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 20 Dec 1972. 70p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.50.

An inventory of installed nuclear capacity and the volume of orders in the world are presented. Statistical data on each power station including the capacity factor, the energy produced, and the availability are given. (auth)

9944 (STI/PUB-300(Vol.10)) PEACEFUL USES OF ATOMIC ENERGY. Volume 10. Proceedings series. Proceedings of the Fourth International Conference held in Geneva, Switzerland, September 6-16, 1971. (International Atomic Energy Agency, Vienna (Austria)). Jul 1972. 618p. (In several languages). (CONF-710901-(Vol. 10)). IAEA $14.00.

From Fourth international conference on the peaceful uses of atomic energy; Geneva, Switzerland (6 Sep 1971).

Separate abstracts have previously appeared in NSA for each of the 36 papers included. (JWR)

9945 ATW-STATISTICS. Nuclear Power Stations 1972: A World Review. Atomwirt., Atomtech.; 18: No. 3, 142-144 (1973). (In German).

A table is given, showing the nuclear power stations of the world which have been in operation, under construction, or ordered in 1972. (GE)

9946 NEW NUCLEAR POWER STATIONS IN EUROPE. Atomwirt., Atomtech.; 18: No. 3, 127-142(1973). (In German).

A review is given of the nuclear power stations in the various European countries which were in operation, under construction, or in the planning stage in 1972. (GE)

9947 WHITE PAPER ON ATOMIC ENERGY, NUMBER 16. Events in Fiscal 1971. Genshiryoku Hakusho; No. 16, 1-204 (Sep 1972). (In Japanese).

Research, development, and utilization of atomic energy in Japan have advanced very steadily, especially in nuclear power generation and radiation utilization, which are thus becoming more significant to the livelihood of people. In the fiscal year 1971, public concern on environmental problems, including that of atomic energy, has especially arisen; on the other hand, with increase of nuclear power generation, stabilized supply of nuclear fuel came to be extremely important. The white paper on atomic energy for the fiscal year 1971 is presented on the following: nuclear power generation, nuclear fuel, enriched uranium, safety, environmental protection, power reactor development, nuclear-powered ships, radiation utilization, atomic energy industry, international cooperation, safeguards, training of nuclear scientists and engineers, and budget concerning atomic energy. (JA)

9948 PRESENT AND FUTURE OF NUCLEAR TRAINING. Elliott, N. S. (Babcock and Wilcox Co., New York). Nucl. Eng. Int.; 18: No. 204, 401-403(May 1973).

Experience at Babcock and Wilcox in preparing reactor operators for license examination is reviewed. Current training programs of operators, maintenance personnel, and supporting personnel such as chemists, engineers, and health physicists are considered and future trends are discussed. (UK)

9949 NUCLEAR POWER-WORKS IN EUROPE: NOW AND LATER. de Meester, P. (Univ., Louvain, Belgium). Ingenieursblad; 42: No. 6, 144-149(1973). (In Dutch).

Requirements for an efficient energy policy are discussed. Supply of energy from nuclear power works today and in the near future is discussed. Finally, reactor types that may become operative at a later time are considered. (auth)

9950 FUTURE OF THE STEAM-POWERED ELECTRICITY WORKS IN FRANCE. Weber, P. (Electricite de France, Chatou). Ingenieursblad; 42: No. 6, 141-143(1973). (In French).

It is shown that the conventional steam-powered electricity works, defined as the basic electricity works, will be progressively replaced by nuclear plants. Low-output steam-powered electricity works are also discussed, which, due to low investment cost, it may be appropriate to operate for supplementing the nuclear plants from 1980 onwards. (auth)

9951 POWER REACTORS '73. Annual Directory of Nuclear Power Projects. Nucl. Eng. Int.; 18: No. 203, 327-364 (Apr 1973).

Information on the world's power reactors is presented in tabular form. An alphabetical listing of all reactors is followed by three main sections giving general information, including size, efficiency, owners, operators, contractors etc., technical parameters, and progress schedules. Preliminary details of stations planned are tabulated separately. (UK)

9952 PATTERN OF THE NUCLEAR ELECTRICITY GENERATING INDUSTRY IN THE 70's AND 80's. Mandel, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Atomwirt., Atomtech.; 18: No. 1, 18-24(1973). (In German).

The probable development of the electricity consumption and the increasing share of nuclear energy in its coverage are shown and based on the example of the FRG. Resulting conclusions can be extended to the USA, EEC (6), UK, and France. Light water reactors will initially have the lion's share in this development because of their lower construction costs, their advanced development status and the higher industrial potential behind them when compared to other reactor types. In order to take full advantage of the possibilities of nuclear energy, however, stronger international cooperation is necessary among the manufacturers, operators, and licensing authorities combined with an opening of the market. To achieve this goal, the initial steps must be made during the introduction of new reactor types like the LMFBR, HTR, and GBR, while allowing for competition on the national and international markets, if cheap electricity is to be assured for the future. (GE)

9953 PRAKTICHESKIE ZADACHI PO EKSPLUATATSII YADERNYKH REAKTOROV. (Problems in the Operation of Nuclear Reactors). Vladimirov, V. I. Moscow; Atomizdat (1972). 184p.

Fundamentals in understanding nuclear reactor operation are outlined, formulas are presented, and concrete engineering problems are solved. The aspects of a reactor as a source of energy and of ionizing radiation, energy release in the core, reactor power levels, and poisoning of a reactor by ^{149}Sm or ^{135}Xe are treated thusly. Reactor control comprises the last third of the book, with the following topics under consideration: subcritical, critical, and supercritical states, reactor control apparatus, reactor startup, operation at predetermined power levels, reactor cooling, shutdown, and accident-free operation. 20 references. (KSW)

9954 NUCLEAR REACTORS. Rigg, S.; Greenlees, F. M. (to United Kingdom Atomic Energy Authority). British Patent 1,309,883. 14 Mar 1973. Filed date 18 Mar 1971. 2p.

Reference is made to methods of transferring heat energy from nuclear fuel to heat energy conversion apparatus. In the system described the heat transferring medium is a substantially void-free finely divided solid moderating material, such as graphite in the colloidal state, which is passed under gravity flow over the fuel. The finely divided material serves both as a moderating and a cooling media, and is non-corrosive and non-abrasive. It is also little changed by continued use. A nuclear reactor construction embodying this system is described. (UK)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 8230, 8635, 8669, 10128–10130, 10132, 10137, 10140–10144, 10146, 10148, 10158, 10159, 10165, 10227–10238, 10246–10250, 10265–10281, 10296–10299, 10301–10304, 10316, 10317, 10322–10324, 10329, 10330, 10339, 10340–10352, 10366, 10379–10383, 10393, 10394, 10417–10419, 10424–10428, 10434, 10438–10440, 10444, 10445, 10450–10453, and 10460.

9955 (GEAP-10542) HIGH POWER DENSITY DEVELOPMENT PROJECT: BIG ROCK POINT REACTOR DEVELOPMENTAL FUEL TESTING. Final Summary Report. Hazel, V. E.; Duncan, R. N. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). Mar 1972. Contract AT(04-3)-361. 66p. Dep. NTIS $5.50.

Developmental fuel assemblies for the Big Rock Point boiling water reactor were irradiated in an 84 bundle core operated at a core average power of 45 kW/liter. Acceptable performance was obtained from Zircaloy-2 clad rods as well as Inconel-600 clad rods while stainless steel 304L clad rods failed. Uranium oxide powder fuel rods also failed due to hydrogenous impurities. (JWR)

9956 (GEAP-13317-1) BWR BLOWDOWN HEAT TRANSFER. First Quarterly Progress Report, July 1–September 30, 1972. Burnette, G. W. (General Electric Co., San Jose, Calif. Atomic

Power Equipment Dept.). Sep 1972. Contract AT(04-3)-189. 59p. Dep. NTIS $5.45.

Single rod BWR Blowdown Heat Transfer (BDHT) tests demonstrated the adequacy of direct type heaters, confirming results obtained in earlier tests. A detailed 16-rod test plan, patterned after the single-rod test matrix, was completed. Procurement activities continued on equipment for the Two-Loop Test Apparatus (TLTA) which will be used for conducting full size, full power, 7 × 7 rod bundle BWR BDHT tests. Further analysis of the test apparatus using BWR blowdown models had indicated that the transient core flow reaches a lower minimum value and that the minimum occurs sooner than in the BWR. Experimental evidence suggests that an early CHF in the test bundle is unlikely, but minor geometric changes, which would provide a more representative core flow transient, are being considered. (auth)

9957 (IKE-5-152) DYNAMIC SIMULATION OF THE COOLING CHANNEL OF A BOILING WATER REACTOR. Dagbjartsson, S.; Jetter, H. (Stuttgart Univ. (West Germany). Institut fuer Kernenergetik). May 1972. 34p. (In German). INIS.

The digital simulation of the cooling channel of a boiling water reactor is described. The channel is reviewed as a system that is one-dimensional dependent on place as well as on time. A program has been compiled in which a subprogram is included for solving the partial differential equations that are used to describe the system. The model formation taking special effects into account which result from the two phases water and steam is discussed. Some results are discussed. Limits and disadvantages are given which are due to the simplified assumptions. (INIS)

9958 (JAERI-M-5015) DESIGN AND CONSTRUCTION OF THE POISON CURTAIN FOR JPDR-II. Izumi, F.; Morishima, A.; Harayama, Y.; Fujita, M.; Shirotori, T. (Japan Atomic Energy Research Inst., Tokyo). Oct 1972. 60p. (In Japanese). NTIS (U. S. Sales Only).

New fuel assemblies and a poison curtain (JPDR-II Poison Curtain) were designed and constructed as part of the JPDR-II Project. In this poison curtain, improvement was made to prevent poison curtain bending due to swelling of the boron stainless-steel. The following are described: construction of JPDR-II poison curtain, difference between JPDR-I and JPDR-II poison curtains, and improvements made in the JPDR-II poison curtain. (auth)

9959 (KFK-1638, pp 7-14) RADIATION PROTECTION EXPERIENCE IN REPAIR WORK AT THE LINGEN NUCLEAR POWER PLANT. Boedege, R. (Kernkraftwerk, Lingen, Ger.). May 1972. (In German).

From Sixth annual scientific meeting of the association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The experience during intensive repair work at the Lingen nuclear power plant is reported. Necessary changes in both organizations and installations are discussed. The increasing contamination with fission products and with radioactivity of corrosion products leads to considerable expenditures. The dose burden of the workers reached such high values as to attain the quarterly permissible dose in several individuals. Introduction of glass dosimeters proved useful and contributed to the exact determination of received doses. Sample checks for incorporation demonstrated that the monitoring of working places was sufficiently effective. (tr-auth)

9960 (KFK-1638, pp 15-19) RADIATION PROTECTION EXPERIENCE DURING REPAIR WORK IN THE GUNDREMMINGEN NUCLEAR POWER STATION. Eickelpasch, N. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Ger.). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The course of internal contamination in those parts of the plant containing primary coolant water and primary steam for an operating period of more than 5 yrs of the nuclear power station Gundremmingen is described. The increase in the inevitable radiation doses received during repair work is shown in a table for some typical operations, which clearly reflects the sharp increase of contamination in the circulation systems. The radiation exposure of the maintenance personnel, broken down according to several groups, is discussed. It is shown that approximately two-thirds of the dose received by the entire plant personnel falls to the maintenance and repair personnel and to the radiation protection group. The main tasks of the radiation protection service during shut-down periods are to record and control the gamma doses received by the maintenance personnel and to prevent the incorporation of radioactivity. These problems are briefly discussed. (GE)

9961 (KFK-1638, pp 237-240) CONTINUOUS MONITORING OF AQUEOUS RADIOACTIVITIES OF KWL. Boedege, R.; Hofmann, W.; Lambers, W. (Kernkraftwerk, Lingen, Ger.); Grosse-Schulte, M. (AEG-Telefunken, Frankfurt am Main). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

In the continuous monitoring of the release of radioactivity, there always is the problem of measuring relatively low concentrations against a relatively high background. It has been found during the preceding period of operation that it is the contamination occurring in the form of suspended particles in water or as organic deposits and films on walls which is of decisive importance. Two examples are given to illustrate ways to eliminate these effects: (1) Monitoring the activity release by means of a 4-1-ring chamber. (2) Monitoring the secondary coolant water for changes in the radioactivity concentration. (GE)

9962 (WASH-1208(6-73)) STATUS OF CENTRAL STATION NUCLEAR POWER REACTORS SIGNIFICANT MILESTONES. (Division of Reactor Development and Technology (AEC), Washington, D. C.). 1 Jun 1973. 11p. Dep. NTIS $3.00.

9963 BARSEBAECK NUCLEAR POWER PLANT. Naeslund, E.; Lindstroem, H.; Hermansen, O. (Sydsvenska Kraft AB, Malmoe, Sweden). Vag- Vattenbyggaren; No. 1, 27-31(1972). (In Swedish).

Construction work for the nuclear power station Barsebäck is described. Unit 1 is planned to be in operation in July 1975 with a power of 580 MW. The design of the cooling water system was preceded by extensive investigations of currents off the coast. The reactor containment is a pressure suppression (PS)-type system and its safety features are presented. (SW)

9964 BOILING WATER REACTOR TRAINING CENTER. Howard, D. E. (General Electric Co., Morris, IL). Nucl. Eng. Int.; 18: No. 204, 415-416(May 1973).

The advanced training facility established at Morris, Illinois, contains a computer-operated control room simulator which is a replica of the Dresden 2 control room. The basic programs for operator training are described and future requirements are discussed. (UK)

9965 NUCLEAR POWER PLANT TRAINING SIMULATOR FOR SWEDISH UTILITIES. Rullgard, A.; Randen, K. (ASEA-ATOM, Vaesteraas, Sweden). Nucl. Eng. Int.; 18: No. 204, 414-415(May 1973).

The simulator described will constitue an essential part of the training program for reactor operators at a joint centre to be established at Studsvik. It is designed for training both BWR and PWR operators and is based on replica control consoles of the Barsebäck 1 and Ringhals 3 power stations. An indication is given of the scope of the simulator. (UK)

9966 STEAM CONDITIONS IN NUCLEAR POWER STATIONS WITH WATER-COOLED REACTORS. Kunegin, E. P.; Kramerov, A. Ya. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 3, 1-5 (Mar 1972).

Translated from Teploenergetika; 19: No. 3, 2-4(Mar 1972).

Optimization of the steam power cycle is considered for single-loop (BWR) and two-loop (PWR) reactors. Superheat is also considered. It is concluded that channel-type BWRs have the best possibilities for economical use of nuclear superheat steam. (DLC)

9967 INVESTIGATING RADIOACTIVE DECOMPOSITION PROCESSES IN REACTOR WATER. Kot, A. A.; Gruzdev, N. I.; Shchapov, G. A.; Tipikin, S. A.; Boguslavskii, V. B. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 1, 38-41(Jan 1972).

Translated from Teploenergetika; 19: No. 1, 31-34(Jan 1972).

In the Beloyarsk-2 nuclear power plant, investigations were carried out on the radioactive decomposition of the water, the extent of decomposition of the NH_3 added to the feedwater, and the formation of nitrates in the reactor zone. Means of suppressing the decomposition and removing the oxygen formed were investigated. Tests were carried out with changes in reactor output from 130 to 360 MW(t). The oxygen content of the saturated steam reaches 6.5 mg/kg. It is shown that it is very difficult to suppress the decomposition by an outside source of hydrogen or by adding ammonia in one-loop BWRs. However, oxygen may be removed from the heating steam condensate by adding hydrazine hydrate. (DLC)

9968 MATERIAL AND CONSTRUCTION PROBLEMS OF NUCLEAR POWER PLANTS WITH LIGHT WATER REACTORS.

Zielinski, J. L. (Technical Univ., Warsaw); Ablewicz, Z.; Jozwik, B. Inz. Budownictwo; 29: 206-213(1972). (In Polish).

General information is given about the technology of nuclear power plants (and their main equipment) with reactors cooled and moderated by light water. Some solutions of reactor houses are presented with descriptions of special buildings solutions and specific building works. (auth)

9969 THERMODYNAMIC DEVELOPMENTS IN BOILING WATER REACTORS. Imhoff, D. H.; Levy, S.; Schraub, F. A. (General Electric Co., San Jose, CA). pp 193-218 of Development of Thermal Techniques in the Nuclear Field and Its Contribution to Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

Five examples of laboratory thermodynamic research conducted by the General Electric Company in support of the design and operation of large boiling water reactors are described. The work defines processes which occur under abnormal and accident conditions and which, as such, cannot easily be investigated at operating reactors. In combination with other thermodynamic and flow tests which can be conducted on the reactors, these researches have contributed vitally to the successful implementation of nuclear power in the form of the boiling water reactor. (auth)

9970 COLIBRI: A COMPUTER CODE FOR SUBCHANNEL ANALYSIS. Devold, I.; Persson, N. O. (AB ASEA-ATOM, Vaestera, Switzerland). pp 229-251 of Development of Thermal Techniques in the Nuclear Field and Its Contribution to Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

The development of a computer program, COLIBRI, which permits an analysis of the thermal performance in every portion of a reactor fuel bundle both radially and axially is discussed. The subchannel code makes it possible to predict the local void fractions and burnout limits at any point in the reactor core which, in turn, results in the use of more realistic safety factors in reactor design. Tests using 36-rod assemblies for heavy water reactors and 64-rod assemblies for light water reactors to obtain experimental data are described, and the measured results are compared with computed results. Very good agreement was found between COLIBRI computations and the subchannel test data. The COLIBRI program can also be used to analyze any heat and mass transfer problems in channels where the medium is allowed to mix in the radial direction. Designers of conventional steam generators can use the program to optimize tubing distance and spacing. (LCL)

9971 BOILING WATER REACTOR INSTRUMENTATION. Preusche, G.; Grosse-Schulte, M. (Allgemeine Elektricitaets Gesellschaft Telefunken, Frankfurt am Main). VGB Kraftwerkstechnik; 53: No. 3, 165-171(1973). (In German).

Out of the numerous measuring points in a boiling water reactor power station, the most important in the reactor pressure vessel and the containment are discussed. Emphasis is on the details of the "philosophy" of instrumentation. Part II deals with the measurement of neutron flux and of reactivity. (GE)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 8635, 8669, 8830, 9962, 9965, 9966, 9968, 10128, 10130, 10132-10136, 10138, 10141, 10143, 10144, 10146-10149, 10156-10159, 10165, 10166, 10222-10226, 10240-10245, 10252-10264, 10282-10296, 10299, 10300, 10305-10315, 10318-10321, 10325-10328, 10331-10338, 10353, 10354, 10359-10365, 10367-10378, 10384-10392, 10395-10416, 10420-10423, 10429-10433, 10435-10437, 10441-10443, 10446-10449, 10454-10459, and 10461-10470.

9972 (AEC-tr-7427) ANALYSIS OF THE PRINCIPAL HYDRAULIC INSTABILITIES AND OF HYDROELASTIC PROBLEMS IN PRESSURIZED-WATER REACTORS. Study Program. Daubert, A.; Pugnet, L.; Boulot, F.; Warluzel, A.; Barrouillet, A. Translated from Houille Blanche; 26: No. 5, 447-450(1971). 11p. Dep. NTIS $3.00.

A program for the study of hydraulic instabilities and hydroelastic problems in pressurized water reactors is described. Flow characteristics independent of structural interactions will be studied first after which all possible coupling processes will be studied. Current plans call for experiments with a 1/10 scale model. (JWR)

9973 (KFK-1638, pp 21-32) RADIATION PROTECTION EXPERIENCE IN REPAIR WORK AT THE OBRIGHEIM PRESSURIZED-WATER REACTOR. Stephan, W.; Wagner, F. (Kernkraftwerk, Obrigheim, Ger.). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

The repair work in nuclear power plants requires that the necessary phases must be completed in as short a time as possible. This includes the actual repair, maintenance, inspection, testing, and occasionally a change of fuel elements. From the standpoint of radiation protection, this presents the tasks of monitoring a large number of work processes and persons. To fulfill these tasks, an organizational structure of radiation protection with subdivision of duties is described in detail. Also reported are the experiences gained during the various phases of repair work, especially the control of contamination, the monitoring of personnel at entrance and exit points, and the monitoring of personnel passing through the cleaning tract of the controlled area. (tr-auth)

9974 (WCAP-8095) POWER SPIKE MODEL FOR STEEL CLAD CORES. Hellman, J. M.; Sipush, P. J. (Westinghouse Electric Corp., Pittsburgh, PA). Apr 1973. 48p.

An evaluation of local power peaking in steel clad fuel rods due to the presence of gaps (pellet separations) in neighboring fuel rods is presented. The development of the local power peaking applicable to Westinghouse steel clad fuel rod cores, is given. The model is developed utilizing flux traces obtained from incore instrumentation. The spike penalty for rod cluster control steel cores and cruciform steel cores is shown. A comparison of the observed flux spikes on these traces to the calculated flux spikes using the model shows the large amount of conservatism in this model. (auth)

9975 NUCLEAR REACTORS. Rigg, S. (to United Kingdom Atomic Energy Authority). British Patent 1,307,072. 14 Feb 1973. Filed date 6 Mar 1970. 1p.

Reference is made to pressure vessels for pressurized water reactors. The pressure vessel described is of cast iron and comprises a cylindrical body consisting of a stack of annular members, a base closure member, a top closure member, with a row of steel bolts clamping these members together between a pair of steel end plates. Each annular member and the base closure member is divided into a number of arcuate parts, with dowels or keys for interlocating the parts relative to each other. Division of the annular members and the bottom closure member facilitates transportation. The body and top closure may be wrapped externally by prestressing cables. A nuclear reactor construction embodying this type of pressure vessel is described. The pressure vessel construction resembles a prestressed concrete structure in performance without the penalty of great weight and bulk. (UK)

9976 WESTINGHOUSE NUCLEAR TRAINING CENTER. French, J. L. (Westinghouse Electric Corp., Zion, IL). Nucl. Eng. Int.; 18: No. 204, 406-408(May 1973).

The joint training facility of Westinghouse and Commonwealth Edison at Zion, Ill., is described. It comprises mainly educational facilities, a 10-kW pool-type Nuclear Training Reactor, simulators, and computer. The training program described consists of fundamental nuclear training and reactor operation, PWR training, and simulator training. Student activities during 1972 are analysed. (UK)

9977 C-E TRAINING FACILITY DESIGNED TO AID THE EXPANSION OF NUCLEAR POWER. McCluskey, R. J. (Combustion Engineering, Inc., Windsor, CT). Nucl. Eng. Int.; 18: No. 204, 411-413(May 1973).

The main feature of Combustion Engineering's training facility for reactor operators is a PWR simulator. Descriptions are given of the simulator and of the training program. Brief details are given of additional services such as assistance in selection of operators and retraining. Supplementary courses for executives and senior personnel are also offered. (UK)

9978 NUCLEAR REACTORS COMPARED. Vrhovac, S. (Federation of Yugoslav Electric Industries). Elektroprivreda; No. 9-10, vp(1972). (In Serbo Croatian).

Nuclear power stations equipped with PWR and VVER reactors, whose main technical characteristics are illustrated, are thoroughly checked out technically and have been in commercial operation for one decade. PWR and VVER reactors also belong to the same reactor family: ordinary water under pressure serving simultaneously as a neutron moderator and as a cooling

agent, with slightly enriched uranium being used as a fuel. The American designation is: Pressurized Water Reactor, or PWR, and the Soviet version is Vodo-Vodyanoy Energeticheskiy Reaktor, or VVER. PWR and VVER plant characteristics are compared. (DLC)

9979 HOW TO MEASURE VIBRATION IN A PWR. Carteus, M.; Gopal, R. Elec. Light Power (Boston); 39-41(Jun 1973).

Measurements and techniques for accumulating base line data on vibration within PWRs is described. Data are being used as reference for subsequent designs. (auth)

9980 ONCE-THROUGH STEAM GENERATION. Sankovich, M. F.; McDonald, B. N. (Babcock and Wilcox, Lynchburg, VA). pp 349-370 of Development of Thermal Techniques in the Nuclear Field and Its Contribution to Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

The design, operating characteristics, and performance of Once-Through (OTSG) and Integral Economizer Once-Through Steam Generators (IEOTSG) developed for delivering superheated steam at constant pressure to turbines in nuclear power plants with PWR-type reactors are discussed in detail. It is concluded that the increase in thermal performance resulting from operating in the IEOTSG mode has been demonstrated and that analytical models developed for predicting the performance of the IEOTSG produced results which compared favorably with experimentally obtained performance data. (LCL)

9981 GENERATION OF MECHANICAL ENERGY USING A PRESSURIZED LIQUID AS THE COOLANT FLUID. (to Babcock Atlantique). French Patent 2,120,322. 18 Aug 1972. Filed date 30 Dec 1970. 5p. (In French).

The problem of generating mechanical energy by vaporizing a working fluid by heat exchange with a pressurized liquid coolant fluid and expanding the vapor produced is considered. The utilization of a working fluid having a temperature and pressure lower than that of the coolant fluid is suggested. In the particular case of pressurized water reactors, a hydrocarbon, such as toluene, could be used as the working fluid. (FR)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 8100, 8427, 8543, 8545, 8607–8611, 8815, 9962, 9966, 10029–10032, 10251, and 10355–10358.

9982 (AEEW-R-847) OBJECTIVES FOR AN HTR R AND D PHYSICS PROGRAMME. Johnstone, I.; Scott, J. A. (Atomic Energy Establishment, Winfrith (England)). Jan 1973. 14p. (CONF-730114-2). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactors; Julich, F. R. Germany (23 Jan 1973).

Important objectives for a HTR R and D program are reviewed and the importance of particular characteristics for safety and reactor performance are discussed. Uncertainties in the physics characteristics influence reactor design through the inclusion of design margins and contingency allowances and may even eliminate certain design variants. The relationship between some important uncertainties and reactor design and operating costs are discussed and targets for the precision with which it should be possible to compute the corresponding physics characteristics are derived. To extrapolate to power reactor conditions, the need for a comprehensive computational scheme validated by an adequate experimental program is emphasized. The reduction in uncertainty as the theoretical and experimental reactor physics development proceeds in order to meet the desired target uncertainty is illustrated with respect to the UK's program in support of the low enriched HTR concept. The current situation for this concept is discussed and compared briefly with that for the Th cycle HTR for which somewhat less zero energy experimental data are available. (auth)

9983 (JAERI-M-4971) REACTIVITY WORTH OF THE CONTROL RODS FOR THE HIGH-TEMPERATURE GAS COOLED REACTOR. Kaneko, Y.; Akino, F.; Kurokawa, R.; Kitadate, K. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 67p. (In Japanese). NTIS (U. S. Sales Only).

Before the final design of the experimental, multi-purpose, high-temperature gas cooled reactor, the reactivity worth of the experimental control rods, simulating those to be used in the reactor, were measured by the pulsed-neutron method. The "experimental" rod is prepared by inserting the cold-pressed graphite pellets containing 10 wt % of B_4C as powder into a thin aluminum cylinder. Thirty different patterns of the control rods are selected such that they are similar to those in the reactor. By comparing the measured reactivity worths with the calculated ones based on the two-group diffusion theory, the following conclusions made: interference effect between the control rods is fairly large, but very small when the distances among the control rods are larger than $6M^2$ (where M^2 is the migration area); reactivity worth of the control rod is not saturated even at 10 wt % B_4C; and the reactivity worth of multiple control rods can be calculated with the accuracy of ±8% by the simple two-group diffusion theory if the extrapolated distance at the surface of the control rods is determined by a semiempirical formula. (auth)

9984 (JAERI-M-5083) VIBRATION OF REACTOR STRUCTURE, II-9. TOROTO-1, -2: Seismic Simulation Program for Core Formed with Blocks. Ikushima, T. (Japan Atomic Energy Research Inst., Tokyo). Dec 1972. 39p. (In Japanese). NTIS (U. S. Sales Only).

Computer code TOROTO-1, -2 was prepared for the simulation of the seismic response of a HTGR core. Features of the code are as follows: behavior of graphite blocks in an earthquake can be represented in a graphic form, the model used is of a discontinuous multi-mass points system, any seismic wave can be treated as the input, numerical analysis is by the so-called "Runge-Kutta-Gills" step-by-step integration method, and the time intervals for calculation and graphic representation can be freely chosen. The code is written in FORTRAN IV. (auth)

9985 (KFK-1638, pp 241-243) RADIATION PROTECTION EXPERIENCE IN THE HTR DEMONSTRATION POWER PLANT OF THE AVR IN JUELICH. Holm, D. (Arbeitsgemeinschaft Versuchs-Reaktor, Juelich, Ger.). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

A table is given to provide a short survey of dose rates at components, personnel dose data, dose rates in the course of handling of fuel and dummy elements, and of radioactivity released to the atmosphere. (GE)

9986 HEAT-RESISTANT METALLIC MATERIALS FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. Yamane, T. (Osaka Univ., Suita, Japan). Seisan To Gijutsu; 24: No. 8, 29-36(Aug 1972). (In Japanese).

Characteristics required for the heat-resistant metallic materials for high-temperature gas-cooled reactors are given as follows: (1) creep resistance at high temperature of 1000°C, (2) capability of production of large parts, (3) prevention of penetration of hydrogen in reducing gas, and (4) resistance to corrosion by trace impurity gas in helium gas. As for the heat-resistant metallic materials, Hastelloy X, Incoloy 800, Inconel 600, and HK 40 were nominated by Japan Atomic Energy Research Institute, for they are available in considerable amount, and have service results. Investigations on these four materials show the following results: penetration of hydrogen at about 1000°C cannot be reduced to zero in any materials; the Incoloy 800 has inferior strength at high temperature, but has given satisfactory results in the use of small design stress; strength of the Inconel 600 is inferior to that of the Hastelloy X; the Hastelloy X shows good strength at high temperature only for short time, accordingly long-time endurance of that strength must be confirmed; the HK 40 has shown good results in petro chemical plants, but inferior toughness and thermal fatigue must be given attention. (JA)

9987 TRAINING OF NUCLEAR OPERATIONAL STAFF WITHIN THE CEGB. Bland, J. F. G. (Central Electricity Generating Board, London). Nucl. Eng. Int.; 18: No. 204, 404-405(May 1973).

An historical summary is given of the development of the facilities for training reactor operator engineers of the Central Electricity Generating Board, from the first training schemes to the new purpose-built Nuclear Power Training Centre at Oldbury. The syllabus aims to provide an appreciation of reactor physics theory and relate this to the CEGB reactors. Current practices in training staff at both supervisory and operational levels within the CEGB are discussed. Simulators are briefly assessed. (UK)

9988 IMPROVING THE CYCLE ARRANGEMENT OF A SINGLE-LOOP NUCLEAR POWER STATION WITH A CHANNEL TYPE REACTOR. Morozov, G. N.; Zorin, V. M. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 3, 6-11(Mar 1972).

Translated from Teploenergetika; 19: No. 3, 4-8(Mar 1972).

An examination was made of the possible improvement of the existing cycle arrangement of the K-500-65/3000 turbine plant of a single-loop nuclear power plant with uranium–graphite channel-type reactor. The additional capital costs necessary are tabulated.

It is concluded that it is economically feasible to increase the feedwater temperature to 195–206°C when the heating surface of the high-pressure heater is made of carbon steel, and to 196–200°C when it is made of 18/8 steel. (DLC)

9989 EXTENDING THE USE OF TURBINE CONDENSERS IN SINGLE LOOP NUCLEAR POWER STATIONS AS STEAM DUMPING UNITS UNDER EMERGENCY CONDITIONS. Al'tshuller, M. A.; Shavarin, V. N. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 3, 12-14(Mar 1972).

Translated from Teploenergetika; 19: No. 3, 8-10(Mar 1972).

To prevent discharge of radioactive steam from single-loop water cooled reactor plants, turbine condensers and bubbling units are used as steam dumping units. But in the Kursk nuclear power plant, the number of bulky bubbling units is reduced, and a gravity-flow cooling water supply to the condenser is provided. The gravity-flow system with the intermediate supply basin is described, and its advantages are listed. (DLC)

9990 NUCLEAR FUEL ELEMENTS. Bairiot, H.; Gaube, M. (to Societe Belge pour l'Industrie Nucleaire). Belgian Patent 787,124. 31 Aug 1972. 5p. (In French).

Fuel elements for a reactor cooled by high temperature gas consist of a block of graphite provided with channels containing the fuel characterized in that the fissionable and fertile materials are separated into distinct stacks. (tr-auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 8095, 9962, 9970, 10131, and 10139.

9991 (KFK-1638, pp 51-56) PROBLEMS OF RADIATION PROTECTION IN THE INCIDENT AT THE LUCENS RESEARCH REACTOR JANUARY 21, 1969. Perotto, C. (Institut fuer Nuklearforschung, Zurich). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

In the Lucens research reactor, defects in one fuel element caused a pressure tube in the moderator tank to explode. The CO_2 of the primary circuit spread over large areas, but contained only small amounts of fission products, D_2O, and tritium. In addition to the dose rate of 100 r per hour, CO_2 suffocation presented a hazard. Good monitoring systems for radioactivity and CO_2 concentration were of utmost importance. The incident demonstrated the need for strict control of personnel movement in the endangered zone; for the available personnel to handle extraordinary situations until the arrival of reinforcements; and for the advanced planning of emergency procedures. (HBG)

9992 (KFK-1638, pp 57-64) EXPERIENCE WITH VARIOUS PROTECTIVE APPROACHES IN STARTING DISMANTLING WORK ON THE LUCENS REACTOR. Nussbaum, J. L. (Centrale Nucleaire de Lucens, Switzerland); Perotto, C. (Institut fuer Nuklearforschung, Zurich). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

Various types of protective clothing were studied during the dismantling work on the Lucens reactor. Work efficiency in highly contaminated areas was hampered severely by protective clothing with PVC but without air cooling. Radiological aprons, worn underneath the PVC clothing, reduced the dose by factors between 2 and 4. The wearing of these heavy clothes without air cooling led to rapid fatigue. It is suggested that personnel undergo prior thorough physical examination, especially with respect to the circulatory and respiratory systems. Well-trained experts could work in normal canvas clothing on surfaces with dose rates up to 1 rad per hour. (HBG)

9993 PROSPECTS OF UTILIZATION OF HEAVY WATER REACTORS AND THE POTENTIAL OF CIRENE REACTORS. Barabaschi, S. (CNEN, Rome); Castelli, G.; Silvestri, M. Energ. Nucl. (Milan); 20: No. 4, 236-242(Apr 1973).

A technical and economical comparison is made between heavy-water reactors (HWRs) and light-water reactors (LWRs). A similar comparison is made between heavy-water-moderated and cooled reactors (PHWHWRs), and heavy-water-moderated, boiling-light-water-cooled reactors (BLWHWRs)—the latter being the type to which the Italian CIRENE reactor belongs. The various aspects in favor of HWRs and particularly of BLWHWRs, emerging from the above comparison, lead to the conclusion that they have excellent chances to succeed on the energy market in competition with LWRs and in a situation of complementarity with the future fast breeder reactors, in the years between 1980 and the end of this century. In particular, the CIRENE reactors might play a primary role, at least in Italy. (auth)

9994 IMPROVED PERFORMANCE FOR UO_2 FUEL. Robertson, J. A. L. (Chalk River Nuclear Labs., Ont.). Eng. J. (Montreal); 55: No. 11-12, 9-13(Nov 1972).

Fuel for all existing and committed CANDU reactors consists of 50-cm bundles of UO_2 fuel pellets in zirconium-alloy sheaths. In Douglas Point Reactor, the bundles are 19 elements in 8-cm diameter pressure tubes; in Pickering 28 elements in 10-cm tubes. Power output from each is 500 W/cm. In Douglas Point, less than 1% of all bundles had failed by mid 1972. Even this failure rate imposes fuel management constraints, so causes of failures had to be eliminated. Hydriding damage was seen to be due to heavy water coolant penetrating the failed element, and so could not be the cause. No excessive sheath corrosion or weld faults, or handling damage were causes but analysis of failures showed they occurred after a power increase following a period of use at lower power. Tests were conducted in NRU test reactor in water loops, where fuel could be moved between positions of low or high power and sheaths, and modified dismountable elements of different thicknesses given extensive tests. Conclusions were that localized stress concentrations in the sheath and aggressive fission products, probably contributed to the failures. Laboratory work showed that a thin layer of graphite applied to the inner surface of the sheath significantly decreased strain concentrations, presumably by lubrication, and protected it from iodine, so a modified UO_2/Zircaloy fuel with a thin graphite layer between fuel and the inner surface of the sheath has been manufactured. (CA)

9995 CIRENE R AND D PROGRAM. Mancini, C. (CNEN, Rome); Villani, S. Energ. Nucl. (Milan); 20: No. 4, 217-235(Apr 1973).

An outline is given of the R & D activities carried on in support of the CIRENE reactor design. The main results obtained in Italy in this frame are compared with the ones obtained in other countries developing pressure-tube heavy-water reactors cooled by boiling light water. (auth)

9996 CIRENE PROTOTYPE. Broggiato, A. (Ente Nazionale per l'Energia Elettrica, Rome); Casagrande, I.; Pedretti, A. Energ. Nucl. (Milan); 20: No. 4, 205-216(Apr 1973).

The CIRENE is a heavy water-moderated, natural uranium-fuelled reactor adopting boiling-light-water cooling. The CIRENE prototype is a 40-MW(e) demonstration reactor that is being realized thanks to an agreement between the Comitato Nazionale per l'Energia Nucleare (CNEN) and the Ente Nazionale per l'Energia Elettrica (ENEL) and with the participation of the Centro Informazioni Studi Esperienze (CISE) as well as of nuclear industry. The main design features of the prototype, its role in the CIRENE program, and the significance of such program in the overall frame of the heavy-water reactor development are discussed. The design of the prototype profits of a well-established technology and at the same time exhibits original features, most remarkably the design choices able to warrant a highly safe performance of the plant. From a technical viewpoint, the prototype appears to be considerably representative—in particular the power channel is practically full scaled—and, from a general viewpoint, it is seen to be actually one of the "classic" heavy-water reactors (which use natural uranium fueling and zirconium–water technology); therefore the realization of the prototype can be viewed in the broader outlook of an advanced solution inserted in an industrially well established frame. (auth)

9997 THERMODYNAMIC STUDIES IN THE DEVELOPMENT OF A NUCLEAR REACTOR. Example of CIRENE and the Possible Relation with Other Industrial Problems. Cerrai, E.; Hassid, A. (CISE, Milan). pp 173-192 of Development of Thermal Techniques in the Nuclear Field and Its Contribution to Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317–.

The thermodynamic research performed during the development of the CIRENE reactor (a pressure tube reactor) can be categorized in three principal phases: feasibility studies, optimization studies, and total verification of the design of the plant and its principal components. In the optimization phase of the research the structure of the two-phase flow in a tube bundle of the type normally used for boiling water reactors was studied. The total verification studies are briefly summarized. (JSR)

9998 RESEARCH AND DEVELOPMENT IN HEAT TRANSFER: CANADIAN REPORT. Smedley, H. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 219-228 of Development of Thermal Techniques in the Nuclear Field and Its Contribution to Other Ap-

plications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317–.

Heat transfer research and development programs of the Atomic Energy of Canada Limited are discussed. This work has centered mainly on fuel bundles operating within a CANDU type pressure tube. Most of the heat transfer work now in progress is related to boiling water reactors. A Freon loop capable of testing a full size channel over the whole range of all significant parameters is being built and is near completion. Confirmatory testing in water will be done in a test loop in the NRU reactor. In addition to these activities aimed at improving reactor design capabilities, experimental studies are examining transient void fraction, heat transfer coefficients of organic coolants, entrainment from a water film injected onto a heater surface through a porous sinter, dry-out heat flux measurements in liquid carbon dioxide, and mixing between channels in a reactor bundle. (LCL)

Power Reactors, Breeding

Refer also to abstracts 8041, 8550, 8551, 8624, 8634, 8665, 8666, 8758, 8759, 10161, 10169, and 10239.

9999 (AI-AEC-13063) LMFBR IN-VESSEL STORAGE REFUELING COMPONENT DEVELOPMENT PROGRAM. Quarterly Technical Progress Report, January–March 1973. (Atomics International, Canoga Park, Calif.). 15 May 1973. Contract AT(04-3)-824. 29p. AT $4.00.

Progress in the development and testing of handling devices for core components for an LMFBR plant utilizing under-the-shield refueling and vessel cover rotating plugs is reported. (JWR)

10000 (ANL–8005) INSTRUMENTATION AND CONTROL ACTIVITIES AT ARGONNE. Annual Report for Period Ending June 30, 1972. Schiebelhut, C. H. (comp.). (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109-Eng-38. 79p. AT $5.45.

The status of instrumentation and control activities in the LMFBR program during fiscal year 1972 is described. Activities supporting near-term objective (e.g., operation of the FFTF) to long-term objective (e.g., commercial LMFBR plants) are described. Reactor monitoring techniques, plant control, FEDAL systems, nondestructive testing, and instrument test facilities are described, as well as the systems for measuring reactor-system parameters. (auth)

10001 (BNWL-CC-2131) COMMENTS ON MASS TRANSPORT AND SCALE-UP PROBLEMS IN CIRCULATING SODIUM SYSTEMS. Lester, D. H. (Battelle Pacific Northwest Labs., Richland, Wash.). 1 May 1969. Contract AT(45-1)-1830. 27p. Dep. NTIS $3.50.

Mass transport of corrosion products in liquid sodium systems is reviewed and the problems in extrapolating laboratory information to large systems are defined. The conclusions are based on a review of selected papers on corrosion and deposition in liquid sodium systems. The goal application of mass transport information is to the design of sodium cooled reactor systems. The relevant sodium literature sampled indicates past work has attempted to come to grips with system intensive variables, T, ΔT, flow, oxygen and materials of construction. It has been silent on system extensive variables, surface-to-volume ratios, cycle time, etc., essential to the extrapolation of data from small systems to large ones. The literature has little to say about hydrodynamic perturbations except to suggest they may be important and must be evaluated. It is concluded that these deficiences in knowledge arise from the absence of a mechanistic mass transport model. While there is currently no valid basis for proposing a model, mechanisms can be reasonably proposed which indicate we have not studied all variables essential to successful extrapolation of laboratory data. Broad outlines of an experimental program are developed which would assure a basis for reliable scale up. (auth)

10002 (EIR-233) ALTERNATE ENERGY CONVERSION SYSTEMS IN GCFR POWER PLANTS. Sarlos, G. (Eidgenoessisches Institue fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00

The results of a comparative study are presented concerning different energy conversion systems with a He-cooled fast-breeder reactor. Designs using gas turbines in a direct cycle are compared with the indirect steam cycle. The main criteria used for this comparison are the plants' economic, safety, and engineering aspects. (auth)

10003 (EURFNR-1059) WEAR BEHAVIOR OF MATERIAL COMBINATIONS IN LIQUID SODIUM: EXPERIMENTAL LAYOUT AND EXPERIMENTAL RESULTS. Wild, E.; Mack, K. J.; Drechsler, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Nov 1972. 67p. (KFK-1659). Dep. NTIS $5.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

An experimental layout has been set up for the investigation of the wear behavior of materials for components of sodium-cooled reactors, which enables reactor conditions during operation to be simulated. The layout worked satisfactorily and enabled all required operating conditions to be run. The ability to stop the four test sections of the plant individually or together, without any interruption in the operation of the main supply and purification circuits, ensured a high degree of availability. The installation of three oxide measuring units (plugging meter, sampling and oxygen measuring probe) permitted satisfactory monitoring and control of sodium purity. (auth)

10004 (GEAP-13823-1) LMFBR HOT CELL REFUELING COMPONENT TESTS. First Quarterly Report, October 1971–March 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept). May 1972. Contract AT(04-3)-189. 29p. Dep. NTIS $3.50.

The work performed under the PA-63 LMFBR Hot Cell Refueling Component Tests program is directed at demonstrating, through environmental development tests, acceptable performance, service life, repair, and maintenance techniques of components for hot cell refueling application. Conceptual designs, including mechanical design and preliminary thermal analysis, were prepared on a fuel transfer container. Conceptual design layouts and design specifications were prepared for a fuel transfer hoist. Closure transfer crane conceptual drawings were revised and updated. Scope design and functional requirements for a refueling hoist were started. A design specification was prepared for an environmental test facility to be used to run environmental tests on refueling equipment components. A design specification was prepared and a scope design initiated on a fuel assembly simulator to be used during various development tests. (auth)

10005 (GEAP-13823-2) LMFBR HOT CELL REFUELING COMPONENT TESTS. Second Quarterly Report, April–June 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jul 1972. Contract AT(04-3)-189. 51p. AT $4.75.

The work performed under the PA-63 LMFBR Hot Cell Refueling Component Tests program is directed at demonstrating, through environmental development tests, acceptable performance, service life, repair, and maintenance techniques of components for hot cell refueling application. The PA-63 program was reoriented as a result of a review meeting between GE and AEC-RDT of Germantown, Maryland, on April 28, 1972. A revised development program plan outlining the proposed testing program is being prepared. Preliminary thermal analysis of the fuel transfer container was performed and a resulting simplified container concept was prepared. (auth)

10006 (GEAP-13823-4) LMFBR HOT CELL REFUELING COMPONENT TESTS. Fourth Quarterly Report, October–December 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jan 1973. Contract AT(04-3)-189. 53p. Dep. NTIS $4.75.

The work performed under PA-63, LMFBR Hot Cell Refueling Component Tests Program, is directed to demonstration of acceptable performance, service life, repair, and maintenance techniques of the generic components which could be used in a hot cell refueling system. This will be accomplished through environmental development tests of specifically designed equipment, such as the fuel transfer container, and commercially available equipment, which may be modified for hot cell use. During this report period detailed design of the fuel transfer container and the grapple-fuel heat simulator was completed. Design of the test setup, facility, and test support equipment for Test 1, Fuel Transfer Components Test, was continued. The experimental proposal and conceptual design for Test 2, Grapple Element Load Tests, was completed. The experimental proposals and detail designs for Test 3, Solidified Sodium Properties Tests, and Test 5, Electrical Power and Control Components Test, were completed. Work was initiated on the conceptual design for Test 6, Power Transmission Component Tests. (auth)

10007 (GEAP-13825-1) LMFBR IN-CORE INSTRUMENTATION AND IN-VESSEL SURVEILLANCE SYSTEMS. First Quarterly Report, January–March 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jul 1972. Contract AT(04-3)-189. 23p. AT $3.25.

Progress in the development of in-core and in-vessel instrumentation for LMFBR use is reported. The research is focused on in-vessel high-temperature neutron detectors and cable assemblies, core and vessel acoustic monitoring systems, and a subcriticality monitoring system. (JWR)

10008 (GEAP-13825-4) LMFBR IN-CORE INSTRUMENTATION AND IN-VESSEL SURVEILLANCE SYSTEMS. Fourth Quarterly Report, October–December 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jan 1973. Contract AT(04-3)-189. 67p. Dep. NTIS $5.45.

The research and development program for in-core and in-vessel instrumentation for LMFBR application is described. Progress is summarized in the development of (1) in-vessel high-temperature neutron detectors and cable assemblies, (2) acoustic monitoring systems for application to the reactor core and vessel, and (3) reactor core exit instrumentation. (HDR)

10009 (GULF-GA-A-12530) GAS-COOLED FAST BREEDER REACTOR. Quarterly Progress Report, November 1, 1972–January 31, 1973. (Gulf General Atomic Co., San Diego, Calif.). 8 Mar 1973. Contract AT(04-3)-167. 111p. Dep. NTIS $7.75.

The tasks of the Gas-Cooled Fast Breeder Reactor (GCFR) program are program planning, core development, development of a pressure equalization system for fuel rods, fuels and materials development, and nuclear analysis and reactor physics. The core development work included analytical studies of the effects of fuel-rod spacer grid misalignment, design and start of construction of a fuel-rod-spacer wear and fretting test, thermal-hydraulic performance of the GCFR fuel element, and a fuel-rod calculation model. A development program plan for the pressure equalization system was prepared. The status of the thermal- and fast-flux irradiation programs is given. The results to date of the fission-gas release data from the vented fuel rod being irradiated in the ORR are given. Reactor physics work was concerned with critical assembly analysis of small-sample worths, comparing the results of GGA and ANL calculations of a 300-MW(e) GCFR core, and defining physics design problems of the GCFR. (auth)

10010 (ORNL-TM-4241) FAST REACTOR EXPERIMENTAL SHIELDING MONTHLY PROGRESS REPORT FOR MARCH 1973. 189a No. 10028, Activity No. 40 01 03 1. Clifford, C. E.; Muckenthaler, F. J.; Stevens, P. N. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 54p. AT $5.45.

The progress made by the ORNL Neutron Physics Division in Fast Reactor Experimental Shielding Research during March is summarized. The Westinghouse demonstration plant side shield experiment was continued during this period. The General Electric radial shield study was completed during this period. Measurements taken on the Westinghouse configurations consisted primarily of a determination of the neutron spectrum using the hydrogen counter for three radial blanket thicknesses and for the case of a 10-in. radial blanket followed by 5-in. stainless steel. For the GE experiments measurements were obtained utilizing both the NE-213 neutron spectrometer and the Bonner ball detectors behind four shield configurations which allowed a comparison of B_4C and stainless steel as alternate shield materials in a typical radial shield configuration. A detailed description and analysis of the shielding materials utilized in both the GE and Westinghouse experiments are included. (auth)

10011 FUEL ELEMENT CLUSTER. Amon, F. (to Licentia Patent Verwaltungs GmbH). German Patent 1,951,091. 22 Apr 1971. Filed date 10 Oct 1969. (In German).

A bundle of fuel elements for a heterogeneous breeder reactor is described in which the rods containing the fissle or fertile material are enclosed by a sleeve in different zones. It is characterized by the fact that the walls of the sleeve are perforated above the fission zone toward the top end of the head of the fuel element. (TSS)

10012 FAST REACTOR TRAINING CENTRE AT DOUNREAY. Nucl. Eng. Int.; 18: No. 204, 417-421(May 1973).

The origin of the Fast Reactor Training Centre at Dounreay was the need for practical instruction to staff engaged in the operation of the PFR, the primary requirement therefore being a course on technology and operation for engineers and scientists. Activities widened to include a course with less technical detail for senior executives and one on sodium technology and handling for staff directly involved. Summaries are given of the contents of each of the three courses. (UK)

10013 THERMAL INSULATION ASSEMBLY. Hind, J. R. (to United Kingdom Atomic Energy Authority). British Patent 1,302,861. 10 Jan 1973. Filed date 20 Feb 1969. 6p.

Reference is made to thermal insulation assemblies for protecting the surface of containers from the effects of high temperature of its contents. The assembly described comprises a number of closely spaced gas pressurized containers in which the surfaces of adjacent containers conform so that passages through the assembly, defined by the spaces between the containers, have a restricted cross-sectional area throughout their length. This arrangement is particularly applicable where the fluid concerned is a good conductor of heat, for example, a liquid metal. The containers may be of two shapes arranged on parallel axes, the first shape being cylindrical and the containers of that shape arranged on a triangular lattice, closely spaced from one another, and the other shape conforming to the interstitial spaces between the cylindrical containers. Transverse thermal baffles may be provided. Application may be to liquid metal-cooled reactors, and such an application is described in detail. (UK)

10014 IMPROVEMENTS IN OR RELATING TO VESSELS. Wharmby, J. S. (to Babcock and Wilcox Ltd.). British Patent 1,305,031. 31 Jan 1973. Filed date 28 Feb 1969. 4p.

Reference is made to Na-cooled nuclear reactors. The Na is at a very high temperature and it is usual to design the heat exchangers so that any welded connections are out of contact with it, to reduce risk of cracking. For additional safety it is usual to fill the space above the Na with a buffer of inert gas. Although a high degree of safety can be achieved in this way there is the disadvantage of the gas becoming entrained in the Na. In the system described a closed vessel is provided having an inlet and an outlet located below the top of the vessel, with a baffle dividing the vessel into an upper part and a lower part containing both the inlet and the outlet. The baffle is provided with one or more upwardly extending vent tubes, providing communication between the upper part of the vessel and the lower part, and one or more apertures through which, when the liquid is above the baffle, the liquid above the baffle is in communication with that below the baffle. Gas occupies the space above the liquid level. No flow through the apertures is induced by the flow of liquid from inlet to outlet. Several vent tubes may be provided, some projecting further below the baffle than the rest, the latter being nearer the outlet. Welded connections lie above the liquid level. (UK)

10015 LEAKAGE OF WATER INTO SODIUM IN STEAM GENERATORS AND TEST RIGS. Greene, D. A. (General Electric Co., Sunnyvale, CA). Nucl. Technol.; 18: No. 3, 267-276(Jun 1973).

When water and sodium react, hydrogen is released to enter cover gas spaces and become absorbed into the sodium. Changes in hydrogen concentration are measured with suitable instruments to monitor steam generator vessels for water leakage. Interpreting the amplitude and rate of change of signals as potential damage to the unit requires two correlations: prediction of the quantity or rate of water injection from changes in hydrogen concentrations, and prediction of heat transfer tube wastage from quantity of water injected or rate of injection of water. Two restricted application correlations covering the worst possible wastage case were developed. The maximum wastage is given by [quantity of metal removed $(in.^3)$] = 0.014 × [quantity of water injected (lb)], and the quantity of hydrogen released by a given quantity of water is shown to be given by a model based on the equilibrium pressure of hydrogen above sodium. These correlations were developed for wastage damage and hydrogen release for a given quantity of water. Based on these correlations, system shutdown criteria were written to guide the operator of a steam generator test rig should a small water-to-sodium leak occur. Predictions from the correlations were used to specify a leak detection system for both a test facility and a plant steam generator. To meet these specifications, it is essential that the in-sodium detection of hydrogen by hydrogen diffusion tube meters become a stable and reliable technique. Operating experience with the leak detection system on the steam generator test rig test facility (which monitored naturally occurring leaks) showed that the shutdown criteria were practical and realistic in guiding system operators. (auth)

10016 THERMOHYDRAULIC ACTIVITIES WITH RESPECT TO THE FAST BREEDER REACTOR DEVELOPMENT IN THE NUCLEAR RESEARCH CENTER KARLSRUHE. Hoffmann, H.; Meerwald, E.; Schultheiss, G. F. (Kernforschungszentrum, Karlsruhe, Ger.). pp 57-78 of Development of Thermal Techniques in the Nuclear Field and Its Contribution to Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317–.

The thermohydraulic work performed and planned within the development of the fast breeder reactors at the Karlsruhe Research Center is described. The thermohydraulic investigations were divided into three categories: thermohydraulic reactor design, experimental work as a basis for reactor design, and theoretical and experimental studies of thermal reactor safety aspects. The first category concentrated on preparing computer programs for calculating temperature fields in the core, fuel bundle, and fuel pin and statistical hot spot analysis. The second category

dealt with evaluating pressure drop, heat transfer, and coolant flow in rod clusters with different geometries and surface roughnesses, and with heat and mass transfer in two-phase flow. The third category studied coolant flow disturbances, boiling phenomena, and sodium–fuel interactions. The significance of this fundamental research to fields of technology other than reactor design is emphasized. (LCL)

10017 SAFETY CRITERIA FOR A HEAT EXCHANGER IN THE PRIMARY CIRCUIT OF A SODIUM COOLED POWER REACTOR. Pavese, M.; Ferrari, G. (Ansaldo Meccanico-Nucleare, Genoa). pp 253-272 of Development of Thermal Techniques in the Nuclear Field and Its Contribution to Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317–.

The basic design criteria of a heat exchanger and the geometric limitations on the design are derived. The demands that the cycle selection makes on the design are tabulated. The problems of superheating and installation are also considered. (JSR)

Research, Test, and Experimental Reactors

Refer also to abstracts 8312, 9505, 9670, and 10180.

10018 (AAEC/TM-620) SUITABILITY OF VARIOUS ACCELERATOR TYPES AS NEUTRON SOURCES FOR PULSED EXPERIMENTS IN FAST REACTOR ASSEMBLIES. Ritchie, A. I. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov 1972. 56p. Dep. NTIS (U. S. Sales Only) $5.00.

Neutron source intensity estimates have been obtained for pulsed die away and pulsed time of flight spectrum measurements in assemblies typical of fast reactor systems for sets of well defined operating parameters, such as neutron pulse length, repetition rate, detector type size and shape, flight path length, energy resolution, etc. Two basic types of assembly were investigated—unfuelled assemblies comprising material typical of the structural material in fast reactors, and fuelled assemblies which covered the range typifying both small fast reactors and large dilute fast reactors. High current (~200 mA) HT sets, dynamitrons, low (~20 MeV), medium (~70 MeV) and high (~200 MeV) energy cyclotrons, low (~15 MeV), medium (~50 MeV) and high (~100 MeV) energy electron LINACS were considered as pulsed neutron sources, and the range of pulsed neutron experiments possible with each of the accelerator types were investigated. It was concluded that the high current HT sets and low energy cyclotrons were inadequate and that medium energy LINACS allowed a range of experiments comparable to high energy LINACS and greater than high energy cyclotrons, while costing significantly less than either of these types of machine. Low energy LINACS, although much less versatile than medium energy LINACS, provided a possible second choice and were preferred to dynamitrons and medium energy cyclotrons. It was also concluded that the performance of LINACS is, in general, much more suited to pulsed experiments in fast assemblies than that of cyclotrons. Bearing in mind the trend in LINAC technology, a LINAC capable of average beam powers of 100 kW at 30–40 MeV appears feasible and would allow a very wide range of experiments. It should have a cost comparable to that of low energy LINACS and less than that of medium energy LINACS. (auth)

10019 (CEA-N-1582) THEORY OF THE EXPONENTIAL EXPERIMENT: APPLICATION OF THE C_N METHOD AND SYNTHETIC SLOWING-DOWN MODELS. Kavenoky, A.; Lorain, H. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 63p. (In French). Dep. NTIS (U. S. Sales Only) $5.25.

The accurate calculation of fast neutron exponential experiments requires the use of transport theory, as space and energy transients cannot be neglected. A method of solving the problem is presented. The method is based on the utilization of the C_N method for the space variable and synthetic slowing-down models for the energy variable. The three-dimensional problem is reduced to the calculation of the relaxation length of an exponential slab. The method is used in conjunction with the HUG and PHUG exponential experiments carried out at Cadarache. The reaction rates for the different detectors are calculated; and a linear combination of the reaction rates, which reduces the transient boundary effects, is used. The effect of parasitic neutrons is studied; and the importance of those coming directly from the reactor source, established. (FR)

10020 (COO-385-10) FORD NUCLEAR REACTOR: EDUCATIONAL AND RESEARCH ACTIVITIES, JULY 1, 1971–JUNE 30, 1972. (Michigan Univ., Ann Arbor. Michigan Memorial Phoenix Project). Sep 1972. Contract AT(11-1)-385. 33p. Dep. NTIS $3.75.

During the academic year 1971–1972, the Ford Nuclear Reactor of The University of Michigan continued to serve as an integral part of the educational and research activities of the University. It also served other schools, hospitals, and industrial research organizations. The continuous operating schedule of the reactor was maintained throughout the year. (auth)

10021 (KFK-1638, pp 65-70) TRITIUM MONITORING IN A RESEARCH REACTOR. Jahn, H. (Kerforschungsanlage, Juelich, Ger.). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

During sample irradiations in the FRJ-2, there was a sudden release of almost 78 kg D_2O, at the reactor top, which had a specific T activity of 3.4 Ci/kg, and the concentration within the reactor hall rose to a maximum of 1.8×10^{-4} μCi/cm^3. The maximum emissive power was 300 mCi/h, with 23 Ci having been emitted on the whole. After the D_2O had been removed from the reactor top, further decontamination measures have been centered on the inner space between top plate and top shielding of the reactor into which penetrated quite a considerable amount of the released D_2O. The respirators that had to be used have been modified in accordance with the various working conditions. By continuously measuring the T concentration at the working positions and by several controls of T incorporation through excretion analyses it was possible to organize the decontamination work in such a manner that the incorporations could be kept very low. Out of 20 persons involved in the decontamination work only one has received a T incorporation of a maximum of 18%, as related to the maximum value set up for continuous exposure. Another group of 8 persons showed a T incorporation of 10 to 15% of the value for continuous exposure. As for the remaining 11 persons, considerably lower values have been found. The amount of T emitted through the exhaust-air stack of the reactor was only 16.5% of the permissible value for a period of one week. The event has shown that even in the case of an unanticipated release of T, continuous T monitoring will guarantee that there is no radiation hazard, either to the operating personnel or to the environment. (GE)

10022 (KFK-1638, pp 71-77) RADIATION PROTECTION ASPECTS IN FUEL ELEMENT LEAKAGE IN THE FRG. Renner, H. (Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

Toward the end of 1970, increased radioactivity in the air of the reactor room indicated leaks from MTR fuel elements. Based on Ge-Li gamma spectroscopy, fission product measurements were conducted with a continuous on-line sampling procedure that permitted the identification of the defective fuel elements. Practical problems of radiation protection are discussed for reactors containing defective fuel elements. (tr-auth)

10023 (KFK-1638, pp 79-87) RADIATION PROTECTION PROBLEMS IN THE CONVERSION OF THE DIORIT HEAVY WATER REACTOR. Conrad, H. (Eidgenoessiches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

In 1967, serious canning defects occurred in the heavy water reactor DIORIT which led to fission product contamination not only of the primary cooling system but also of the D_2O and He purification equipment. The reactor was shut down and the entire D_2O system was decontaminated. Practical experience was gained about the organization of the reconstruction group, calculation of expected dose rates, surface contamination, disposal and disposition of radioactive waste, actual radiation doses to personnel, and air contamination. Altogether, the reconstruction went smoothly and the actual radiation exposure of personnel was lower than expected. (HBG)

10024 (ORNL-TM-3884) MIGRATION OF A CLASS OF FISSION PRODUCTS (NOBLE METALS) IN THE MOLTEN-SALT REACTOR EXPERIMENT. Kedl, R. J. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 93p. Dep. NTIS $6.75.

The Molten-Salt Reactor Experiment (MSRE) is a fluid-fueled experimental nuclear reactor; consequently, fission products are dispersed throughout the entire fuel circulation system. One group of fission products, referred to as noble metals, exists in the fuel

salt in the reduced metallic state. They are insoluble and unwet by salt. They deposit on surfaces exposed to salt such as the Hastelloy N piping and the moderator graphite. They apparently accumulate in a stable form on the liquid-gas interface in the fuel pump. The amounts of noble metals on these surfaces and on other deposition sites have been measured. These measurements have been analyzed within the framework of mass transfer theory. The analysis has been found to correlate the data from these sources in a unified manner. It is therefore concluded that the noble metals do migrate in accordance with mass transfer theory, although some parameters still remain unevaluated. A hypothesis is presented to explain some of the dramatic differences in reactor operating characteristics between the ^{235}U and ^{233}U runs. It is recommended that additional noble metal deposition experiments be conducted in a circulating salt loop. (auth)

10025 (TID-26321) REACTOR SHARING PROGRAM. Final Report, December 1, 1971–November 30, 1972. Wilson, W. E. (Washington State Univ., Pullman. Nuclear Radiation Center). 8 Mar 1973. Contract AT(45-1)-2221. 11p. Dep. NTIS $3.00.

Activities in the reactor sharing program at Washington State University from December 1, 1971 through November 30, 1972 are summarized. (JWR)

10026 (USNDC-3, pp 38-42) 24.5-keV NEUTRON BEAM FACILITY AT THE HFBR REACTOR. Wasson, O. A. (Brookhaven National Lab., Upton, NY); Chrien, R. E.; Greenwood, R. G. 1973.

From the U. S. Nuclear Data Committee meeting; Argonne, Illinois, USA (24 Oct 1972).

In reports to the U. S. Nuclear Data Committee meeting at National Bureau of Standards, 24–26 October 1972.

10027 IMPROVED PERFORMANCE FUEL ELEMENTS FOR BR2. Bobin, K. J.; Lenders, H. J. (Commission of the European Communities, Brussels). Nucl. Eng. Int.; 18: No. 204, 418-421 (May 1973).

The continuously increasing demand for the irradiation of heavily absorbing experimental rigs and the need for a longer running time per cycle led to the fissile charge of the BR2 fuel elements being increased from 244 g ^{235}U per element to 400 g per element without any change in dimensions. This involved changing from alloy core plates to cermet cores fabricated by powder technology, and necessitated the incorporation of burnable poisons. The work associated with the project and the manufacturing difficulties encountered are described. The effect of the change on reactor operation is discussed. (UK)

10028 COLD NEUTRONS. Harig, H. D. (Kernforschungsanlage, Juelich, Ger.). Umschau; 72: No. 1, 25-26(1972). (In German).

For some nuclear experiments, low-energy neutrons are necessary. They can be obtained by installing a cryostat containing liquid hydrogen or liquid deuterium within the normal moderator. A cold neutron source of liquid deuterium which promises better results than previous low-energy neutron sources is provided for the French–German high-flux reactor at Grenoble. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstract 10022.

10029 (DUN-7294-A) PRODUCTION TEST AUTHORIZATION NUMBER 239, SUPPLEMENT I. 117-N Filter Building Charcoal Sampling Program. Bennett, E. C. (Douglas United Nuclear, Inc., Richland, Wash.). 22 Dec 1972. 11p. Dep. NTIS $3.00.

An authorization to continue the study of impregnated charcoals to determine the effects of the reactor atmosphere on their ability to adsorb organic iodides is presented. These effects are studied under reactor operating conditions, with normal air flow through the filters, and also under static exposure of the charcoal to the reactor atmosphere. The charcoal sampling and testing for this production test will also satisfy the operational testing required under EMS-603 during the test period. The test period will continue to charcoal exposure periods up to 18 months. (auth)

10030 (DUN-7751-B) REDUCED DEMINERALIZED WATER TEMPERATURE. Final Report for DT-278. Bainard, W. D.; Newell, L. J. (Douglas United Nuclear, Inc., Richland, Wash.). 13 Oct 1972. 13p. Dep. NTIS $3.00.

A potential fuel oil cost saving was indicated during a short duration experiment on May 25, 1971, when demineralized water temperature was lowered from 95°F to 57°F with no measurable increase in dissolved oxygen level being observed. Original specification requirements for the 163-N demineralizer plant called for an effluent dissolved oxygen concentration of less than 7 ppb at a design throughput rate of 3000 gpm. To attain the very low dissolved oxygen levels, the vendor stipulated the need for heating the water to 100°F prior to degasification and provided a steam heater for this purpose. When N Reactor is shutdown, the 100°F water temperature is obtained by heating with steam supplied from the 184-N boiler complex. Based upon the results obtained in the May 25, 1971, experiment, Development Test 278, "Reduced Demineralized Water Temperature," DUN-7751, was formulated to determine if lower water temperature at varying flow rates was a critical factor in demineralized water quality and demin plant operation. Results obtained from the testing program are presented. (auth)

10031 (DUN-8065) N-REACTOR FUEL COLUMN SPACER TESTING FOR THE THIRD GENERATION PERFORATED SPACER DESIGN. Pursley, D. L. (Douglas United Nuclear, Inc., Richland, Wash.). 15 Feb 1973. 48p. Dep. NTIS $4.50.

In the Fall of 1969, charge–discharge of N-Reactor fuel was initiated with the V-12 diversion valves undiverted. This procedural change was justified by the extensive delays and personnel exposure involved with operation of the V-12 valves. At the same time this new procedure was adopted, fuel element spacers began jamming in the area of the outlet port during discharge. The investigation of this problem indicated that the change in coolant flow conditions with the undiverted V-12 valves resulted in spacer jamming on a high percentage of discharged fuel columns. Resolution of this problem became important to reduce charging delays and the potential for damaging green fuel. An alternate spacer support design was developed to eliminate the jamming problem. A group of test spacers were procured with the new support design in two configurations (three at 120° intervals and four at 90° intervals). Acceptability of the new spacers is based on tests designed to compare the critical features of the new design and present design. Four separate tests were performed. The first test determined if the new spacers passed the original requirement of the design, which is, that they do not hang up at the nozzle port. The second, third, and fourth tests involved determining if the new design meets criteria for hydraulic characteristics, support structural integrity, and impact absorbing capability. Testing was completed by the Mechanical Development Engineering Unit of the Engineering Section under an Engineering Request. This report discusses the test results and provides a technical basis to support a change in spacer design. (auth)

10032 (DUN-8148) COMPILATION OF A TRITIUM CONTROL TECHNOLOGY STATUS REPORT. Engler, A. E. (Douglas United Nuclear, Inc., Richland, Wash.). 21 Mar 1973. 8p. Dep. NTIS $3.00.

Experience with tritium at the N Reactor resulting from the irradiation of tritium production target elements is reported. Areas covered include monitoring, trapping and removal, handling and containment, and packaging for storage and disposal. (JWR)

10033 (ORNL-TM-4245) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT JANUARY–MARCH 1973. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 22p. Dep. NTIS $3.25.

Reactor operation was routine with an on-stream time of 91.6%. The semiannual reactor component inspection was completed and the control plates were changed. All of the 44 hold-down nuts on the reactor vessel top head were changed. This completes the replacement of the reactor vessel top head studs and nuts. A major modernization of the instrumentation in the reactor protection and control system was completed. (auth)

Propulsion and Package Reactors

Refer also to abstracts 8059 and 10207.

10034 (AI-AEC-13065) GEOM: A THERMAL-HYDRAULIC STRESS CODE. Moody, E. (Atomics International, Canoga Park, Calif.). 10 May 1973. Contract AT(04-3)-701. 85p. Dep. NTIS $5.45.

The GEOM computer code (IBM/360) is described as it existed at the SNAP program close out. The code performs thermal, hydraulic and stress analysis on a liquid metal ZrH reactor core. The theory and empirical data used are described in detail. Instructions for using the code are given with a sample problem for illustration. (auth)

10035 (KFK-1638, pp 33-42) RADIATION PROTECTION EXPERIENCE IN OPERATION OF THE NUCLEAR-POWERED COMMERCIAL SHIP "OTTO HAHN". Henning, K. (Kernenergiever-

werting in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). May 1972. (In German).

From sixth annual scientific meeting of the Association for Radiation Protection at the Place of Work; Karlsruhe, Germany (17 May 1972).

In October 1968, the advanced pressurized water reactor of the "Otto Hahn" attained for the first time its full power of 38 MW thermal. Since this start in the Kiel Fjord, the first European nuclear commercial vessel, which was built essentially for research purposes, has traveled about 205,000 nautical miles (10 times the earth circumference) in 74 voyages without incidents. During the voyages, a total amount of 283,000 tons of phosphates and ores were transported. Up to the end of the life expectancy for the first core—the second core will be installed in the fall of 1972—no damage to the fuel elements with steel canning occurred; thus, the radiation protection situation onboard was normal even during special phases of maintenance and repair. As a consequence, only experiences during normal operations were described, especially those technological and organizational features that are typical for commercial vessels. Heat exchanger damage, occurring toward the end of 1971, caused only such a low specific activity of the primary water as to pose no particular problems for radiation protection. (tr-auth)

10036 (N-72-33651) GAMMA HEATING IN REFLECTOR HEAT SHIELD OF GAS CORE REACTOR. Lofthouse, J. H.; Kunze, J. F.; Young, T. E.; Young, R. C. (Aerojet Nuclear Co., Idaho Falls, Idaho). Aug 1972. 37p. (NASA-CR-120903; ANCR-1077). NTIS.

Heating rate measurements made in a mock-up of a BeO heat shield for a gas core nuclear rocket engine yields results nominally a factor of two greater than calculated by two different methods. The disparity is thought to be caused by errors in neutron capture cross sections and gamma spectra from the low cross-section elements, D, O, and Be. (auth)

10037 (N-73-12692) DEVELOPMENT OF RF PLASMA SIMULATIONS OF IN-REACTOR TESTS OF SMALL MODELS OF THE NUCLEAR LIGHT BULB FUEL REGION. Roman, W. C.; Jaminet, J. F. (United Aircraft Corp., East Hartford, Conn. Research Labs.). Sep 1972. Contract SNPC-70. 130p. (NASA-CR-129299; L-910900-12). NTIS.

Experiments were conducted to develop test configurations and technology necessary to simulate the thermal environment and fuel region expected to exist in in-reactor tests of small models of nuclear light bulb configurations. Particular emphasis was directed at rf plasma tests of approximately full-scale models of an in-reactor cell suitable for tests in Los Alamos Scientific Laboratory's Nuclear Furnace. The in-reactor tests will involve vortex-stabilized fissioning uranium plasmas of approximately 200-kW power, 500-atm pressure and equivalent blackbody radiating temperatures between 3220 and 3510°K. (auth)

10038 (N-73-14710) FABRICATION OF FUEL PIN ASSEMBLIES: PHASE 3, FINAL REPORT. Keeton, A. R.; Stemann, L. G. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Dec 1972. Contract NAS3-14415. 130p. (NASA-CR-120956; WANL-M-FR-72-4). NTIS.

Five full size and eight reduced length fuel pins were fabricated for irradiation testing to evaluate design concepts for a fast spectrum lithium cooled compact space power reactor. These assemblies consisted of uranium mononitride fuel pellets encased in a T-111 (Ta-8W-2Hf) clad with a tungsten barrier separating fuel and clad. Fabrication procedures were fully qualified by process development and assembly qualification tests. Detailed specifications and procedures were written for the fabrication and assembly of prototype fuel pins. (auth)

10039 (NAA-SR-6022) SNAP 8 REACTOR DEVELOPMENT. Bi-Monthly Progress Report, October–November 1960. Johnson, C. E. (ed.). (Atomics International, Canoga Park, Calif.). 15 Mar 1961. Contract AT(11-1)-GEN-8. 22p. Dep. NTIS $3.25.

Declassified 3 May 1973.

Progress is reported on the SNAP 8 reactor development project stating objectives, progress made, and evaluation of effort to date. Reactor analysis, fuel and component development data, and reactor operating data obtained from the SNAP 2 program form the basis of the SNAP 8 reactor development program. Further development is required to meet the SNAP 8 objectives of 600 kW(t) power and 1300°F NaK outlet temperature. The development effort on SNAP-8 currently emphasizes core analysis, fuel development, and mechanical design. A hydraulic model of the reactor core has been built, instrumented and placed in operation. Test results indicate that the optimum coolant flow profile can be achieved in the reactor. Two fuel capsules are being fabricated for shipment to the ETR for irradiation. Corrosion tests on core structural materials were conducted in 1400°F NaK for durations of 2000 to 3500 hours. (auth)

10040 (NAA-SR-6294) PROGRESS REPORT SNAP 10A NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT, DECEMBER 1960–MARCH 1961. Thiele, A. W. (Atomics International, Canoga Park, Calif.). 15 Jun 1961. Contract AT(11-1)-Gen-8. 31p. Dep. NTIS $3.75.

Declassified 24 May 1973.

Progress is reported giving objectives, evaluation of work to date, and effort evaluation of SNAP 10A reactor. The area of major interest is system design thermoelectric converter development and fabrication. Other areas of reactor development, including nuclear analysis and component development are covered. The bulk of the effort on the conduction-cooled SNAP 10 system configuration was terminated and its activities were redirected to the convection-cooled concept, designated SNAP 10A. Specifications were revised to include increase of electrical output from 300 W to at least 500 W over the system lifetime of 1 yr. A vehicle integration scheme was devised. Design work is being carried on to conform to the revised basic requirements; design for a converter has been completed, and components are under development. Test system design has started and testing is scheduled. (auth)

10041 (NAA-SR-6320(Vol.1)) MERCURY RANKINE PROGRAM (SNAP 2). Development of Liquid-Mercury-Lubricated Bearings. Volume I. Analytical Design Approach and Status of Bearing Systems (with Appendixes). Decker, O. (TRW Equipment Labs., Cleveland, Ohio). [nd]. Contract AT(11-1)-Gen-8. 196p. Dep. NTIS $12.00.

For Atomics International, Canoga Park, Calif. Declassified 24 May 1973.

Requirements and the limited state of the art complicated the analytical design and development of fluid film bearings lubricated by liquid mercury for systems such as SNAP. The demands for long life, maximum reliability, minimum system weight, and operation in space are reflected in such things as restrictions on permissible supply pressure, flow rate, temperatures, usable materials, and construction. The high rotational speed of the shaft, coupled with the low kinematic viscosity of liquid mercury, assures bearing operation beyond the laminar flow regime. Operation was assumed in the little-investigated turbulent and superlaminar flow regimes. Despite these difficulties, the feasibility of liquid-mercury-lubricated fluid film bearings was demonstrated by a series of endurance tests on different bearing types. The longest test to date is in excess of 6000 hours on a single set of bearings. The analytical and experimental activities of the bearing development program are covered. The design approach progressed from the use of empirically corrected laminar flow equations to the use of more nearly fundamental considerations of high Reynolds number (turbulence) effects. Semi-empirical analytical techniques and nondimensional design curves were generated as a by-product of a predominantly hardware-oriented development program. These techniques and procedures permit the design and performance of hydrodynamic and hybrid bearings operating at Reynolds numbers (based on radial clearance) up to 10,000. (auth)

10042 (NAA-SR-6561) THERMAL DESIGN OF SNAP REACTORS. Cohn, P. D. (Atomics International, Canoga Park, Calif). 1 Feb 1962. Contract AT(11-1)-GEN-8. 66p. Dep. NTIS $5.50.

Declassified 17 Apr 1973.

10043 (NAA-SR-6693) SNAP 10A NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT. Progress Report, April–June 1961. (Atomics International, Canoga Park, Calif). 15 Nov 1961. Contract AT(11-1)-GEN-8. 74p. Dep. NTIS $5.75.

Declassified 17 Apr 1973.

Progress is reported stating objectives, summary to date, discussion of system and tests, development program, and system analysis. During the report period major development activities have centered on the thermoelectric power conversion system. Primary activities have been concentrated on the required encapsulant. A major continuing effort is the coordination of interface consideration between the SNAP 10A system and the launch vehicle. (auth)

10044 (NAA-SR-6694) SNAP 2/10A REACTOR PROGRESS REPORT, APRIL–JUNE 1961. Haussler, W. M. (Atomics Internationa, Canoga Park, Calif). 1 Dec 1961. Contract AT(11-1)-Gen-8. 20p. Dep. NTIS $3.00.

Declassified 24 May 1973.

Progress covering the objectives of the SNAP 2/10A reactor system, analysis, component, and fuel development is reported. Reference design points for nuclear, shielding, and heat transfer parameters were established. A new 4-drum configuration has been adopted to meet flight objectives. Procurement has been initiated for fuel materials for reactors. (auth)

10045 (NAA-SR-6991) SNAP 2 NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT. Progress Report, October-December 1961. Shackelford, M. (ed.). (Atomics International, Canoga Park, Calif.). 1 May 1962. Contract AT(11-1)-GEN-8. 78p. Dep. NTIS $6.00.
Declassified 17 Apr 1973.

10046 (NAA-SR-6992) SNAP 8 REACTOR DEVELOPMENT. Progress Report, October-December 1961. (Atomics International, Canoga Park, Calif.). 15 Aug 1962. Contract AT(11-1)-GEN-8. 85p. Dep. NTIS $6.25.
Declassified 17 Apr 1973.

10047 (NAA-SR-6993) SNAP 10A NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT. Progress Report, October-December 1961. (Atomics International, Canoga Park, Calif.). 26 Mar 1962. Contract AT(11-1)-GEN-8. 122p. Dep. NTIS $8.25.
Declassified 17 Apr 1973.
Progress is reported on objectives, summary to date, discussion of system and tests, developmental program, and system analysis. Developmental, production and testing work on three thermoelectric power conversion systems, two using PbTe encapsulant and one using SiGe, was continued. In late December the decision was made to continue development of only the one using SiGe. Data collected up to that time established the superiority of this material. Testing of the first flight prototype system, PSM-1, was initiated and indicated the necessity for redesign of the structure. Redesignation of the two prototype systems to be delivered to the vehicle contractor as nonpower producing units, was received from the AEC. (auth)

10048 (NAA-SR-6996) PROGRESS REPORT FOR SNAP SUPPORTING R AND D, OCTOBER-NOVEMBER 1961. Roberts, W. J. (ed.). (Atomics International, Canoga Park, Calif.). 15 Feb 1962. Contract AT(11-1)-Gen-8. 22p. Dep. NTIS $3.25.

10049 (NAA-SR-7021) DESIGN, ANALYSIS, AND FABRICATION OF THERMOELECTRIC MODULES FOR SNAP 10A. King, P. P.; Meyers, G. W. (Atomics International, Canoga Park, Calif.). 1 Jun 1962. Contract AT(11-1)-GEN-8. 35p. Dep. NTIS $3.75.
Declassified 17 Apr 1973.
The design, analysis, and fabrication development of lead telluride thermoelectric modules for the SNAP 10A thermoelectric converter are discussed in detail. Two designs were developed that could be fabricated with a high assurance of quality and thermoelectric continuity. Twenty-seven 26-element modules were fabricated during a three-week period, to demonstrate production capabilities and to supply modules of flight configuration for performance testing. (auth)

10050 (NAA-SR-7048) ASSEMBLY OF S-2 DR FUEL ELEMENTS. Dennison, W. F.; Jakobowski, T. S. (Atomics International, Canoga Park, Calif.). 15 Dec 1962. Contract AT(11-1)-Gen-8. 25p. Dep. NTIS $3.25.
Declassified 24 May 1973.
Fifty-one fuel elements were produced for the SNAP Developmental Reactor (S-2 DR). The procurement of the materials used in cladding these elements, and the fabrication, assembly, and testing of the elements are described. (auth)

10051 (NAA-SR-7064) ENCAPSULATION OF LEAD TELLURIDE THERMOELECTRIC ELEMENTS. Groce, I. J.; Reed, E. L. (Atomics International, Canoga Park, Calif.). 1 Jun 1962. Contract AT(11-1)Gen-8. 22p. Dep. NTIS $3.25.
Declassified 24 May 1973.
One thermoelectric material that might be used in the Systems for Nuclear Auxiliary Power (SNAP 10A) converter was lead telluride (PbTe). In order to use PbTe in this converter, under the environmental conditions of 900°F and vacuum, it was necessary to prevent sublimation loss of the PbTe, by encapsulation or some other method, without exceeding a 5% heat shunt or a 1% electri shunt through the encapsulation material. Several encapsulating methods were tried, including plasma flame spraying of ceramic sleeves, vapor deposition of ceramics, electrophoretic deposition of ceramics, coating with heat curing cements, and spraying and firing of enamels. The spraying and firing of enamel onto the thermoelectric element proved to be the best method, although some promise was shown with sleeves. Weight loss test data has shown that the fired enamel could be expected to protect the PbTe for 40,000 to 80,000 hr at 900°F in vacuum, before reaching a 5% PbTe sublimation loss. The goal was 10,000 hr. Weight loss test data also indicated that sleeve encapsulation would improve sublimation protection. If the sleeve could also be used to hold the elements in compression, it might also prevent resistance degradation of the p-type PbTe elements. (auth)

10052 (NAA-SR-7192) SNAP 8 PROGRAM QUARTERLY PROGRESS REPORT, JANUARY-MARCH 1962. Johnson, C. E. (ed.). (Atomics International, Canoga Park, Calif.). 1 Dec 1962. Contract AT(11-1)-GEN-8. 110p. Dep. NTIS $7.50.
Declassified 17 Apr 1973.
Progress is reported on objectives of the SNAP 8 Reactor Development program and shield, fuel, and component development. The experimental program for the testing of the SNAP 8 Experimental Reactor (S8ER) has been detailed. The test program for the SNAP 8 Ground Prototype Test (S8DS) has been outlined and the basic system descriptions written. (auth)

10053 (NAA-SR-7194) SNAP 2/10 REACTOR PROGRESS REPORT, JANUARY-MARCH 1962. (Atomics International, Canoga Park, Calif.). 26 Oct 1962. Contract AT(11-1)-Gen-8. 57p. Dep. NTIS $5.00.
Declassified 24 May 1973.
Concluded and in progress activities of the SNAP 2/10 Reactor Program are detailed and summarized. Activities include SNAP 2 reactor core fluid flow studies, completion of fabrication of SCA-4C, modification of SNAP 2 shield design, effects of water immersion accidents, reentry safety studies, emissive coating evaluations, hydriding operations, fuel element assembly development, and various tests of reactor materials and components. (auth)

10054 (NAA-SR-7195) PROGRESS REPORT FOR SNAP 4, JANUARY-MARCH 1962. (Atomics International, Canoga Park, Calif.). 1 Jul 1962. Contract AT(11-1)-Gen-8. 22p. Dep. NTIS $3.25.
Declassified 24 May 1973.
Progress is reported on project objectives, summary to date, and development progress during period reported on. Fuel development and irradiations continued on a limited basis. A proposal to modify Phase I of the original SNAP 4 program, to incorporate a rod-type core in the development system, is being prepared for submission. (auth)

10055 (NAA-SR-7495) PROGRESS REPORT FOR SNAP 4, APRIL-JUNE 1962. (Atomics International, Canoga Park, Calif.). 31 Mar 1963. Contract AT(11-1)-GEN-8. 35p. Dep. NTIS $3.75.
Declassified 17 Apr 1973.
Progress is reported on program objectives, program summary, design description, and reactor analysis. A preliminary fuel specification was issued, following analytical investigations. Preliminary Specification Data Sheets were revised, and preparations made to issue Design Specifications in the next quarter. A master PERT network for S4ER was prepared. Capsule irradiations continued. (auth)

10056 (NAA-SR-7529) EFFECTS OF VIBRATION AND SHOCK ON HYDROGEN PERMEATION OF SNAP 2/10A DEVELOPMENTAL FUEL ELEMENTS. Fitzgerald, A. J. (Atomics International, Canoga Park, Calif.). 1 Mar 1963. Contract AT (11-1)-GEN-8. 42p. Dep. NTIS $4.25.
Declassified 17 Apr 1973.
An experimental program was performed to study the hydrogen retention qualities of SNAP 2/10A developmental fuel elements of various designs after these elements had been subjected to simulated launch vibration and shock conditions. The variance in the N_H of the fuel rods and the nonisothermal test temperatures necessitated normalizing the measured permeation rates in order to form a consistent basis of comparison. Previously derived permeation equations were used for the normalization. All elements of the developmental designs which were tested had acceptable permeation rates for the SNAP 10A reactor. (auth)

10057 (NAA-SR-7791) PROGRESS REPORT FOR SNAP 2 NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT, JULY-SEPTEMBER 1962. Sinizer, D. I. (ed.). (Atomics International, Canoga Park, Calif.). 15 Feb 1963. Contract AT(11-1)-Gen-8. 95p. Dep. NTIS $6.75.
Declassified 24 May 1973.
Progress on SNAP 2 system development is summarized. Performance tests of the combined rotating unit are underway. Alternate bearing configurations are being studied. Performance analysis of the prototype flight system was completed and performance characteristics calculated. The turbine will operate at 36,000 rpm. The alternator will produce 1800 cps ac at 76/132 v with a calculated efficiency of 87%. Mercury boiler performance tests revealed that the boilers operate as predicted. A comprehensive test plan has been devised for testing. A test system for horizontal radiator-condensers is being installed. (auth)

10058 (NAA-SR-8295) FINAL REPORT ON THE SNAP 2 DEVELOPMENT REACTOR (S2DR) TEST PROGRAM. Felton, L. D.; Beall, J. P.; Burton, J. H.; Camhi, I. I.; Oliver, D. G.;

Randall, R. L. (Atomics International, Canoga Park, Calif.). 3 Apr 1964. Contract AT(11-1)-GEN-8. 151p. Dep. NTIS $9.75.

Declassified 3 May 1973.

The SNAP 2 Developmental Reactor (S2DR) achieved criticality on April 3, 1961, and operated until December 21, 1962, at which time it was shut down and disassembled. The history of the reactor from fuel loading through disassembly is presented. Experimental measurements of the reactor characteristics are described and the results are reported. The reactor was in operation for 11,290 hr to accumulate a total energy release of 272,900 kWh. Included in the operation were 2060 hr at 55 kW and 1200°F outlet temperature, 1544 hr at 30.5 kW and 1100°F, and 1150 hr at 30.5 kW and 950°F. There were no reactor failures during the testing period. At design temperature (1200°F outlet) the reactor had an isothermal temperature coefficient of −0.29¢/°F and a power coefficient (for constant inlet temperature and design flow) of −0.9¢/kW. Equilibrium xenon poison at 55 kW was 23.6¢. (auth)

10059 (NAA-SR-8430) SNAP 8 EXPERIMENTAL REACTOR FABRICATION AND ENGINEERING. Campbell, D. C.; Decker, H. D.; Kirsch, T. S.; Martin, C. A.; Schrag, F. C. (Atomics International, Canoga Park, Calif.). 1 Mar 1964. Contract AT (11-1)-GEN-8. 55p. NTIS $4.75.

Declassified 3 May 1973.

Laboratory procedures were successfully scaled up in the production of 215 fuel elements for the SNAP 8 Experimental Reactor (S8ER). Chemical and metallurgical characteristics of the finished fuel were acceptable. The average hydrogen permeation rate of the delivered elements was one-third of the maximum acceptance limit. The dimensional acceptability of the elements was shown by the absence of problems in assembling elements into the core. This report describes the processes and equipment used to fabricate the fuel elements. The process capabilities developed during fabrication are discussed with regard to quality and quantity. (auth)

10060 (NAA-SR-8692) SNAP 8 QUARTERLY PROGRESS REPORT, APRIL-JUNE 1963. Johnson, C. E. (ed.). (Atomics International, Canoga Park, Calif.). 27 Sep 1963. Contract AT(11-1)-GEN-8. 223p. Dep. NTIS $13.25.

Declassified 3 May 1973.

Progress is reported covering SNAP 8 reactor development program including objectives, design description, system analysis, component development, and system tests. Several minor changes have been made in the reference design to improve system reliability. The conditions required for stable reactor operation during the power conversion system startup have been established. Fuel was loaded into the S8ER and the dry critical experiments completed. Design changes have been made in the S8DS and S8FS facilities. (auth)

10061 (NAA-SR-8740) SNAP 8 DESIGN DESCRIPTION. Mason, D. G. (Atomics International, Canoga Park, Calif.). 1 Aug 1963. Contract AT(11-1)-GEN-8. 54p. Dep. NTIS $4.75.

Declassified 3 May 1973.

10062 (NAA-SR-8985) EFFECT OF SIMULATED FUEL SWELLING ON HYDROGEN PERMEATION OF SNAP 8 FUEL ELEMENTS. Fitzgerald, A. J. (Atomics International, Canoga Park, Calif.). 15 Mar 1964. Contract AT(11-1)-Gen-8. 35p. Dep. NTIS $3.75

Declassified 24 May 1973.

The effect of diametrical fuel swelling on the hydrogen permeation of SNAP 8 fuel elements was investigated. The in-pile fuel swelling was simulated by hydriding short lengths of SNAP 8 fuel rod within ceramic coated cladding assemblies. Hydrogen permeation through the assembly was correlated with the fuel-ceramic clearance. (auth)

10063 (NAA-SR-9293) PROGRESS REPORT, SNAP 10A NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT, OCTOBER-DECEMBER 1963. Stewart, J. (Atomics International, Canoga Park, Calif.). 15 Feb 1964. Contract AT(11-1)-Gen-8. 189p. Dep. NTIS $11.50.

Declassified 24 May 1973.

The first full power endurance run was initiated on a complete SNAP 10A system. Testing has continued on the thermoelectric power conversion modules with no failures experienced to date on the flight type units. During this report period, flight prototype pumps have been produced and successfully tested. The balance of the SNAP 10A program, including the launch support activities is proceeding normally. (auth)

10064 (NAA-SR-9392) SNAP 8 PROGRESS REPORT, OCTOBER 1963-JANUARY 1964. Johnson, C. E. (Atomics International, Canoga Park, Calif.). 16 Mar 1964. Contract AT(11-1)-GEN-8. 272p. Dep. NTIS $15.75.

Declassified 17 Apr 1973.

Progress is reported covering SNAP 8 nuclear system development program including objectives, design description, system analysis, component development, and system tests. The SNAP 8 reactor's capability to produce 600 kwt at 1300°F appears satisfactory on the basis of S8ER power operation to date. Final assembly of S8DRM-1 was initiated. (auth)

10065 (NAA-SR-9394) SNAP 10A REACTOR PROGRESS REPORT, OCTOBER 1963-JANUARY 1964. Gimera, R. J.; Johnson, R. A. (Atomics International, Canoga Park, Calif.). 16 Mar 1964. Contract AT(11-1)-Gen-8. 102p. Dep. NTIS $7.25.

Declassified 24 May 1973.

Modifications made to the ground test kit, and which appear to have increased the reliability of the kit, are described. Shipping sleeve drop tests were performed and are described. New analyses of reactor startup behavior were made for a number of different conditions which should bracket all anticipated situations in flight. Long-term endurance components development tests were continued. Significant progress was made on the reactor component qualification program. (auth)

10066 (NAA-SR-9407) SNAP 2 REACTOR ADVANCED PERFORMANCE CAPABILITY STUDY. Gylfe, J. D.; Balkwill, J. K.; Flynn, W. A.; McGoff, D. J.; Nathan, M. E.; Susnir, J.; Watrous, J. D.; Wilde, J. D. Jr. (Atomics International, Canoga Park, Calif.). 2 Jun 1964. Contract AT(11-1)-GEN-8. 45p. Dep. NTIS $4.25.

Declassified 17 Apr 1973.

10067 (NAA-SR-9486) SNAP 10A THERMOELECTRIC PUMP DEVELOPMENT. Perlow, M. A. (Atomics International, Canoga Park, Calif.). 3 Jun 1964. Contract AT(11-1)-Gen-8. 127p. Dep. NTIS $8.50.

Declassified 24 May 1973.

The SNAP 10A system and pump requirements are presented to define the developmental objectives of the thermoelectric pump. Design equations and procedures are included along with operating data and their respective analyses. Fabrication problems are discussed, and the procedure for manufacture of both the elements and the pump assembly is included. Post-test examination by metallographic means was performed on pumps subsequent to 1000°F NaK operation. (auth)

10068 (NAA-SR-9496) QUALIFICATION TESTING SNAP 10A FUEL ELEMENTS (INTERIM REPORT). Fitzgerald, A. J. (Atomics International, Canoga Park, Calif.). 15 Jun 1964. Contract AT(11-1)-GEN-8. 91p. Dep. NTIS $6.75.

Declassified 17 Apr 1973.

An experimental program is being performed to demonstrate the reliability of SNAP 10A fuel elements to withstand simulated reactor conditions. This interim report summarizes results available to date, which show that insignificant damage has been caused by the prescribed thermal and mechanical inputs. Based on the available data, demonstrated reliability, at the 50% confidence level, is shown to be 98.95% for a single element, and 67.80% for a core load of 37 elements. These values are the reliability demonstrated for the elements to withstand thermal cycle, vibration and shock, ramp heating, and 90 days of thermal endurance. Nine of the 66 elements have completed one year of thermal endurance at 1100°F, with a total hydrogen loss of <0.3%. Endurance testing of the remaining 57 elements continues. (auth)

10069 (NAA-SR-9592) SNAP 8 QUARTERLY PROGRESS REPORT, FEBRUARY-APRIL 1964. Johnson, C. E. (Atomics International, Canoga Park, Calif.). 15 Jun 1964. Contract AT(11-1)-GEN-8. 273p. Dep. NTIS $15.75.

Declassified 17 Apr 1973.

Progress is reported covering SNAP 8 nuclear system development program including objectives, design description, system analysis, component development, and system tests. The S8ER accumulated 60 days of operation at 450 kW(t) and 1300°F coolant outlet temperature. The S8DRM-1 reactor assembly test was completed. (auth)

10070 (NAA-SR-9594) SNAP 10A REACTOR. Quarterly Progress Report, February-April 1964. Gimera, R. J.; Johnson, R. A. (Atomics International, Canoga Park, Calif.). 15 Jun 1964. Contract AT(11-1)-GEN-8. 87p. Dep. NTIS $6.50.

Declassified 17 Apr 1973.

The GTK fabrication and testing program was completed. Coarse drum drive assemblies are ready for demonstration and acceptance tests. New fuel loadings were established for S10-FS-1, -3, and -4. Test data for S10A control drum actuators were accumulated for a reliability study of the S10-FS-1 System. (auth)

10071 (NAA-SR-9618) SNAP 8 EXPERIMENTAL REACTOR (S8ER) HYDROGEN BARRIER COATING DEVELOPMENT. Webb, R. W. (Atomics International, Canoga Park, Calif.). 15 Jun 1964. Contract AT(11-1)-Gen-8. 34p. Dep. NTIS $3.75.

Declassified 24 May 1973.

The SNAP 8 Experimental Reactor (S8ER) fuel element operating conditions required development of a hydrogen barrier material for use at higher temperatures than was the case with SNAP 10A. A ceramic coating was developed similar in composition to the SNAP 10A coating (Solaramic S14-35A), but free of all materials readily reducible in a hydrogen environment at 1500°F. This new coating (AI8763D) possessed a higher deformation temperature, slightly lower hydrogen permeation rate, and greater stability in hydrogen than Solaramic S14-35A. Coating compositions, procedures, and test data are reported. (auth)

10072 (NAA-SR-9642) SNAP 8 EXPERIMENTAL REACTOR CRITICAL EXPERIMENT. Crouter, D. E. (ed.). (Atomics International, Canoga Park, Calif.). 15 Sep 1964. Contract AT(11-1)-GEN-8. 44p. Dep. NTIS $4.25.

Declassified 17 Apr 1973.

A prototype reactor core and reflector assembly manufactured for the SNAP 8 Experimental Reactor was subjected to a series of dry critical experiments prior to final assembly and power operation. Experimental results are interpreted in terms of: (a) the critical fuel loading, (b) the effects of reflector thickness, (c) the control element reactivity worths, (d) the effects of varying fuel and moderator densities, (e) the reactivity worths of special fuel and absorber rods, (f) the reactivity worths of the internal reflectors, (g) the β_{eff}/l ratio, and (h) the power density distributions. (auth)

10073 (NAA-SR-9646) RESPONSE OF THE SNAP 8 REACTOR DURING AUTOMATIC STARTUP. Birken, S. (Atomics International, Canoga Park, Calif.). 24 Sep 1964. Contract AT (11-1)-Gen-8. 66p. Dep. NTIS $5.50.

Declassified 24 May 1973.

To determine the response of the SNAP 8 nuclear system to automatic startup, the system was simulated using both digital and analog computer models. Parameter studies were made to determine the effects of startup source size, NaK coolant flow, temperature coefficients, and additional drum rates on both fuel temperature transients and startup time. The detailed results of the parameter studies are presented. The analog model and digital program are discussed in detail, including circuit diagrams, equations, and constants used in the simulation. (auth)

10074 (NAA-SR-9754) SNAP 10A REACTOR NUCLEAR ANALYSIS. Dayes, A. R.; Flynn, W. A.; Hawley, J. P. (Atomics International, Canoga Park, Calif.). 15 Jan 1965. Contract AT(11-1)-Gen-8. 77p. Dep. NTIS $6.00.

Declassified 24 May 1973.

A physical description of the SNAP 10A reactor and a description of the calculational models employed for nuclear analysis are presented. Analytical methods and sources of nuclear constants are discussed. Where available, experimental results are compared to analytical results. The nuclear characteristics of the reactor are tabulated and discussed. Reactor safety devices are described and their analysis is presented. Analysis of the first ground test reactor, S10FS-1, is also included. (auth)

10075 (NAA-SR-9896) PERFORMANCE TESTING SNAP 8 EXPERIMENTAL REACTOR FUEL ELEMENTS: INTERIM REPORT. Parker, T. G. Jr.; Veeck, S. J. (Atomics International, Canoga Park, Calif.). 15 Aug 1964. Contract AT(11-1)-GEN-8. 122p. Dep. NTIS $8.25.

Declassified 17 Apr 1973.

A group of 54 SNAP 8 fuel elements were subjected to nonnuclear reactor environments to determine performance characteristics. Mechanical inputs as high as 250% of the design level resulted in little, if any, degradation. Performance test data indicate that the fuel elements were degraded by time at temperature and/or transient heating and cooling received prior to thermal endurance testing. However, continuous exposure of fuel elements to 1300 or 1400°F temperatures in the thermal endurance tests has resulted in decreasing permeation rates. Projection of present data to 10,000 hr indicates a 13 wt % hydrogen loss at an isothermal 1400°F, or a 5 to 6 wt % hydrogen loss under reactor gradient conditions. (auth)

10076 (NAA-SR-9901) MECHANICAL DESIGN OF THE SNAP 10A RADIATION SHIELD. Sutherland, J. D. (Atomics International, Canoga Park, Calif.). 30 Jun 1964. Contract AT(11-1)-GEN-8. 27p. Dep. NTIS $3.50.

Declassified 17 Apr 1973.

10077 (NAA-SR-9991) SNAP SYSTEMS IMPROVEMENT PROGRAM. Mercury Rankine Program. Progress Report, April-June 1964. (Atomics International, Canoga Park, Calif.). 15 Aug 1964. Contract AT(11-1)-Gen-8. 183p. Dep. NTIS. $11.25.

Declassified 24 May 1973.

Performance and endurance testing with Mercury-Rankine prime components based on the former 3-kW(e) SNAP 2 flight requirements continued. Objectives were established for the development of building-block components of a basic modular size with a 3- to 5-kW(e) range. These components must be capable of use in multiple power conversion-system configurations, operation in man-rated missions, compatibility with the SNAP 8 reactor, and shutdown and restart operation in multiple system designs. Several of the component development programs have already been reoriented to the new requirements. (auth)

10078 (NAA-SR-9992) SNAP 8 QUARTERLY PROGRESS REPORT, MAY-JULY 1964. Johnson, C. E. (Atomics International, Canoga Park, Calif.). 22 Sep 1974. Contract AT(11-1)-Gen-8. 254p. Dep. NTIS $14.75.

Declassified 24 May 1973.

Progress is reported on the SNAP 8 nuclear system development program including objectives, design description, system analysis, component development, and system tests. A new primary loop design point has been determined. The S8ER completed 1000 hours operation at 600 kW(t) and 1300°F coolant outlet temperature. The S8DRM-1 low level shock and vibration test was completed. (auth)

10079 (NAA-SR-9993) PROGRESS REPORT, SNAP 10A NUCLEAR AUXILIARY POWER UNIT DEVELOPMENT, APRIL-JUNE 1964, SNAP 10A RELIABILITY STATUS. (Atomics International, Canoga Park, Calif.). 20 Nov 1964. Contract AT(11-1)-Gen-8. 110p. Dep. NTIS $7.50.

Declassified 24 May 1973.

The SNAP 10A program is oriented to demonstrate space flight performance of a nuclear thermoelectric power generating system. Extensive ground testing is being undertaken to simulate all flight environments and verify system performance prior to actual flight. The ground test program is subdivided into development, prequalification and qualification tests at the component, subsystem, and system level. The SNAP 10A test program has been scheduled such that the component and subsystem performance is verified by extensive qualification tests prior to major systems tests. The component qualification program is essentially complete. Endurance tests on major components are continuing. System behavior will be verified by nuclear and nonnuclear systems tests conducted in a thermal vacuum environment following shock and vibration testing to simulate the launch phase. Reliability of the SNAP 10A system operating under actual space flight conditions based on test data is evaluated. (auth)

10080 (NAA-SR-9996) PROGRESS REPORT FOR SNAP (SYSTEMS FOR NUCLEAR AUXILIARY POWER) GENERAL SUPPORTING TECHNOLOGY, MAY-JULY 1964. Mims, L. S.; Courson, R. G. (Atomics International, Canoga Park, Calif.). 30 Sep 1964. Contract AT(11-1)-Gen-8. 28p. Dep. NTIS $3.50.

Declassified 24 May 1973.

Results of the General Supporting Technology Program using three shielding analysis codes—SHOE, CLUB, and ANNEX-3 are completed and checked out. Safety analyses tests relative to operation of SCA-5 are included. (auth)

10081 (NAA-SR-10022(Add.1)(Rev.)) FINAL SNAPSHOT SAFEGUARDS REPORT. Addendum I. Hart, R. S. (ed.). (Atomics International, Canoga Park, Calif.). 20 Mar 1965. Contract AT(11-1)-Gen-8. 25p. Dep. NTIS $3.25.

Declassified 24 May 1973.

Information and/or analysis pertinent to the safety of the SNAPSHOT Program which has become available since May 1, 1964, the imposed cutoff for data used in the preparation of the Final SNAPSHOT Safeguards Report are presented. (auth)

10082 (NAA-SR-10027) OBSERVATIONS ON THE PROPERTIES AND BEHAVIOR OF EARLY SNAP 8 HYDROGEN PERMEATION BARRIERS. Carpenter, H. W. (Atomics International, Canoga Park, Calif.). 15 Apr 1965. Contract AT(11-1)-Gen-8. 35p. Dep. NTIS $3.75.

Declassified 24 May 1973.

Small specimens were aged under the most severe reactor conditions anticipated (1400 and 1500°F at 1 atm of hydrogen) for 50 to 2000 hr. The following observations were made: alkaline oxides in the Solaramic S14-35A barrier were reduced by the hydrogen atmosphere, chromizing the Hastelloy N substrate before application of the coatings was beneficial in decreasing coating defects and in promoting a more stable interface, significant devitrification of

the glass coatings occurred within the first 100 hr, the coefficient of thermal expansion changed, but the change was not detrimental to the coatings, and coating porosity increased from 8 to 30% in some areas in both coating. Based on these results, five recommendations were made for producing a more stable coating: use a formula low in easily reducible oxides, make the frit from calcined, high-purity oxides, quench the molten glass with water-cooled metal rollers and vacuum outgas the frit, crystallize the coating under controlled conditions, and refine the chromizing process. (auth)

10083 (NAA-SR-10174) IDENTIFICATION OF THE MODIFIER IN SNAP FUEL. Taketani, H.; Silverman, L.; Korst, W. L. (Atomics International, Canoga Park, Calif.). 1 Feb 1965. Contract AT(11-1)-Gen-8. 20p. Dep. NTIS $3.00.

Declassified 24 May 1973.

Stoichiometric zirconium carbide powder is added to SNAP fuel during the melting of the zirconium-uranium alloy, in order to prevent cracking of the fuel element during the subsequent hydriding process. During melting, zirconium carbide reacts with zirconium to form substoichiometric zirconium carbide. This reaction probably continues while the alloy is maintained at high temperature during the hydriding process. The major portion of the substoichiometric zirconium carbide, ZrC_{1-y}, reacts with hydrogen during the hydriding process to form a ternary compound with the approximate stoichiometry of $ZrC \cdot ZrH_x$, where x can approach 2. (auth)

10084 (NAA-SR-10490) SNAP REACTOR IMPROVEMENT PROGRAM. Progress Report, July–September 1964. Gimera, R. J.; Susnir, J. (Atomics International, Canoga Park, Calif.). 31 Dec 1964. Contract AT(11-1)-GEN-8. 59p. Dep. NTIS $5.00.

Declassified 3 May 1973.

Interim SNAP Reactor program effort included initiation of the design package to be used to fabricate the reactor, qualification test of the developmental test shield, and completion of fabrication of all components (except the electrically actuated band release device (EABRD)) for the SNAP 2 DRM assembly. A conceptual design of the SNAP 10B Reactor was completed based on parametric studies and results of critical experiments. A potential fuel element has been developed. Two devices appear promising as temperature coefficient augmenters. (auth)

10085 (NAA-SR-10500) TESTING S8DRM-1 FUEL ELEMENTS (INTERIM REPORT). Fuller, W. D.; Whitlock, J. D. (Atomics International, Canoga Park, Calif.). 30 Jun 1965. Contract AT(11-1)-GEN-8. 34p. Dep. NTIS $3.75.

Declassified 3 May 1973.

The SNAP 8 reactor mockup uses a flight design reactor and shield, but employs dummy and normal uranium fuel elements. The tests are nonnuclear development tests which are the first steps in the qualification of the complete SNAP 8 nuclear system. Thirty-nine fuel elements (normal U) were manufactured for testing. Twenty-four of these contained the AI8763-D hydrogen barrier and 15 contained the SCB barrier. The fuel element test program was planned to evaluate designs, measure performance characteristics, and provide design criteria for future SNAP 8 fuel elements. To fulfill these objectives, the fuel elements are subjected to a series of nonnuclear inputs simulating reactor conditions. The effect of each input is evaluated on the basis of hydrogen loss rates before and after each input. Performance tests of the elements support the following conclusions: 1) axial spacers between fuel and cladding are not required to protect the fuel element from damage during vibration, shock, and acceleration inputs which simulate normal launch; 2) axial spacers did not withstand the vibration, shock, and acceleration inputs; 3) when tested under similar conditions, performance of the S8 mockup fuel elements is better than the performance of fuel elements used in the SNAP 8 Experimental Reactor; and 4) during early testing, the average hydrogen loss rate of fuel elements with AI 8763-D ceramic was generally lower than that of fuel elements with SCB ceramic. Thirteen of the fuel elements, 7 with SCB coating and 6 with AI 8763-D coating, were subjected to the S8 mockup tests. After the tests, the average hydrogen leak rate from the 7 SCB coated fuel elements was lower than the average leak rate from the 6 AI 8763-D coated fuel elements. Twenty-four of the elements are now undergoing 10,000-hour endurance test. (auth)

10086 (NAA-SR-10515) FISSION GAS RELEASE FROM LIGHTLY IRRADIATED SNAP 8 FUEL MATERIALS. Willis, A. H.; Moses, A. J. (Atomics International, Canoga Park, Calif.). 15 Sep 1965. Contract AT(11-1)-Gen-8. 30p. Dep. NTIS $3.50.

Declassified 24 May 1973.

SNAP 8 fuel materials have been studied by low-level irradiations, followed by a variety of annealing treatments. From these tests, it is concluded that the $\epsilon - \delta$ phase transition does not promote gas release. Other transitions can cause massive gas release, and the importance of these phase transitions is burnup dependent. The gas release obtained from this material indicates that it will perform satisfactorily at reference reactor temperatures under circumstances where hydrogen loss does not promote phase transitions. Where phase transitions do occur, sudden fission gas release can be anticipated for any reasonable burnup levels. This suggests a swelling region at high burnup levels. (auth)

10087 (NAA-SR-10859) SNAP 8 NUCLEAR SYSTEMS FOR UNMANNED AND MANNED APPLICATIONS. Mason, D. G. (Atomics International, Canoga Park, Calif.). 15 May 1965. Contract AT(11-1)-Gen-8. 71p. Dep. NTIS $5.75.

Declassified 24 May 1973.

An unmanned SNAP 8 reference design and a man-rated SNAP 8 reference concept are described in detail. Performance characteristics of each at the reference design point of 600 kW(t), 1300°F outlet coolant temperature are given showing how high reliability for 10,000 hours of operation is attained. Off-design performance operation as it affects reliability and operating life is also discussed. Curves to estimate shield weights for each design are presented as a function of payload separation distance, payload diameter, neutron and gamma doses, dose rate, and reactor power level. The SNAP 8 nuclear system application potential is given, along with a summary of the development status. (auth)

10088 (NAA-SR-10903) SNAP 8 EXPERIMENTAL REACTOR OPERATIONS AND TEST RESULTS. Fead, L. M.; Felton, L. D.; Rooney, V. L. (Atomics International, Canoga Park, Calif.). 28 Jun 1965. Contract AT(11-1)-GEN-8. 42p. Dep. NTIS $4.25.

Declassified 3 May 1973.

The SNAP 8 Experimental Reactor test program was designed to measure reactor performance characteristics and to demonstrate SNAP 8 reactor performance at rated conditions of 600 kW(t) and 1300°F core coolant outlet temperature. Nuclear operations were conducted for over 12,000 hours, including 100 days of operation at rated conditions, one year of operation at system conditions of 400 kW(t) or greater with a core coolant outlet temperature of 1300°F, and over 5,000 hours of continuous operation at 450 kW(t). The test program provided experimental evaluations of the reactor performance characteristics including power and isothermal temperature coefficients, poisoning effects, and hydrogen loss reactivity effects. (auth)

10089 (NAA-SR-11092) SNAP 8 PROGRESS REPORT, FEBRUARY–APRIL 1965. Johnson, C. E. (Atomics International, Canoga Park, Calif.). 15 Jun 1965. Contract AT(11-1)-Gen-8. 131p. Dep. NTIS $8.75.

Declassified 3 May 1973.

Progress is reported on the SNAP 8 nuclear system program including objectives, design description, system analyses, component development, and system tests. The S8ER test program was completed as scheduled on April 15, 1965 after achieving 1 year of operation at 400 to 600 kW(t) with a 1300°F NaK outlet temperature. The S8ER test program included over 5000 hours of continuous power operation, which is believed to be a new record for uninterrupted operation of a reactor in the United States. (auth)

10090 (NAA-SR-11096) PROGRESS REPORT FOR SNAP (SYSTEMS FOR NUCLEAR AUXILIARY POWER) GENERAL SUPPORTING TECHNOLOGY, FEBRUARY–APRIL 1965. Mims, L. S. (Atomics International, Canoga Park, Calif.). 30 Jun 1965. Contract AT(11-1)-Gen-8. 36p. Dep. NTIS $4.00.

Declassified 17 Apr 1973.

Nuclear experiments using clean and poisoned cores were performed with the SCA-5 critical assembly. Experimental data and analytical predictions are compared. Investigative experiments of mercury supersaturation behavior were initiated; preliminary efforts are described. Preliminary results of irradiation tests to investigate the effects of different neutron and gamma spectra in producing radiation damage to silicon semiconductors are presented. The continuing development and use of the several analytical codes utilized in reactor analysis are described. (auth)

10091 (NAA-SR-11584) ANALYSIS OF SNAPTRAN-3 DESTRUCTIVE EXPERIMENT DEBRIS. Culley, G. E. (Atomics International, Canoga Park, Calif.). 15 Dec 1965. Contract AT(11-1)-GEN-8. 36p. Dep. NTIS $4.00.

Declassified 3 May 1973.

The SNAPTRAN-3 destructive experiment was conducted as one of the major projects in the Aerospace Nuclear Safety Program. The analysis of reactor core debris resulting from the transient experiment is reported. Sections of fuel, cladding, and other core components were examined to determine failure mechanisms and

the extent of damage incurred during the transient. Metallography of the fuel debris was used to develop a model for fuel disintegration. It was concluded that temperatures reached during the experiment were not sufficient to cause melting of any of the core components. Fuel material disintegration was caused by the generation of hydrogen pressure within the fuel, resulting in stresses in excess of the strength of the material. The reactor was destroyed by the rapid release of large quantities of hydrogen within the core at pressures in excess of the strength of the core components. (auth)

10092 (NAA-SR-11685(Vol.2)) SNAP SYSTEMS CAPABILITIES. Volume 2. Study Introduction, Reactors, Shielding. (Atomics International, Canoga Park, Calif.). 1 Dec 1965. Contract AT(11-1)-Gen-8. 149p. Dep. NTIS $9.50.
Declassified 17 Apr 1973.
The qualities and capabilities of nuclear reactor space power systems are described. The development status of SNAP reactors and shielding is surveyed. (JWR)

10093 (NAA-SR-11691(Vol.1)) SNAP SYSTEMS IMPROVEMENT PROGRAM. Volume I. Progress Report, July–September 1965. (Atomics International, Canoga Park, Calif.). 15 Nov 1965. Contract AT(11-1)-Gen-8. 66p. Dep. NTIS $5.50.
Declassified 24 May 1973.

10094 (NAA-SR-11691(Vol.2)) SNAP SYSTEMS IMPROVEMENT PROGRAM: MERCURY RANKINE PROGRAM. Volume II. Progress Report, July–September 1965. (TRW Equipment Labs., Cleveland, Ohio). 27 Dec 1965. Contract AT(11-1)-Gen-8. 80p. Dep. NTIS $6.00.
For Atomics International, Canoga Park, Calif. Declassified 24 May 1973.

10095 (NAA-SR-11755(Vol.2) SNAP SYSTEMS IMPROVEMENT PROGRAM: MERCURY RANKINE PROGRAM. Volume II. Progress Report, October–December 1965. (TRW Equipment Labs., Cleveland, Ohio). 15 Mar 1966. Contract AT(11-1)-Gen-8. 150p. Dep. NTIS $9.50.
For Atomics International, Canoga Park, CA. Declassified 24 May 1973.

10096 (NAA-SR-11758) SNAP 8 PROGRESS REPORT, OCTOBER 1965–JANUARY 1966. Mason, D. G. (Atomics International, Canoga Park, Calif.). 8 Apr 1966. Contract AT(11-1)-Gen-8. 129p. Dep. NTIS $8.50.
Declassified 24 May 1973.

10097 (NAA-SR-11759) PROGRESS REPORT, SNAP AEROSPACE NUCLEAR SAFETY PROGRAM, OCTOBER–DECEMBER 1965. Detterman, R. L. (Atomics International, Canoga Park, Calif.). 15 Feb 1966. Contract AT(11-1)-Gen-8. 51p. Dep. NTIS $4.75.
Declassified 24 May 1973.

10098 (NAA-SR-11760(Vol.2)) ADVANCED THERMOELECTRIC DEVELOPMENT PROGRAM. Volume II. Progress Report, November 1965–January 1966. (Radio Corp. of America, Harrison, N. J.). 31 Mar 1966. Contract AT(11-1)-Gen-8. 72p. Dep. NTIS $5.75.
For Atomics International, Canoga Park, CA. Declassified 24 May 1973.

10099 (NAA-SR-11886(Vol.2)) SNAP SYSTEMS IMPROVEMENT PROGRAM: MERCURY RANKINE PROGRAM. Volume II. Progress Report, January–March 1966. (TRW Equipment Lab., Cleveland, Ohio). 30 May 1966. Contract AT(11-1)-Gen-8. 137p. Dep. NTIS $9.00.
For Atomics International, Canoga Park, CA. Declassified 24 May 1973.

10100 (NAA-SR-11955) SNAP 10A POWER CONVERSION SYSTEM DESIGN AND TEST. Rocklin, S. R.; Johnson, J. L.; Lepisto, L. L.; Mike, M.; Willard, R. M. (Atomics International, Canoga Park, Calif.). 30 Jun 1966. Contract AT(11-1)-Gen-8. 114p. Dep. NTIS $7.75.
Declassified 24 May 1973.

10101 (NAA-SR-11956) END-OF-LIFE SHUTDOWN STUDIES. Interim Report. Moore, K. E. (Atomics International, Canoga Park, Calif.). 30 Jun 1966. Contract AT(11-1)-Gen-8. 25p. Dep. NTIS $3.25.
Declassified 17 Apr 1973.
Dissociation pressure studies have been conducted to obtain a measure of the effect of tritium additions on the dissociation pressure of zirconium hydride. It was found that 1% tritium additions did not measurably affect the total pressure. Additional studies performed on ZrH_x and ZrT_y have shown that $ZrT_{1.70}$ has a dissociation pressure 1.6 times that of $ZrH_{1.70}$. Annealing experiments were performed on U-ZrH_x fuel specimens containing measured amounts of tritium and helium-3. Density measurements on fuel specimens annealed at 1300 and 1500°F showed that the ^3He resulting from 1% tritium additions will have a negligible effect compared to irradiation-induced fuel swelling and growth. (auth)

10102 (NAA-SR-12029) POSTOPERATION EVALUATION OF FUEL ELEMENTS FROM THE SNAP 8 EXPERIMENTAL REACTOR. Olson, P. S.; Miller, K. J.; Donovan, E. J. (Atomics International, Canoga Park, Calif.). 15 Sep 1967. Contract AT(04-3)-701. 218p. Dep. NTIS $13.00.
Declassified 3 May 1973.
The S8ER nuclear test was operated to determine reactor core performance characteristics and to demonstrate limited operation at design power. The S8ER was a NaK-cooled, highly enriched uranium-zirconium hydride fueled, compact nuclear power system, designed to operate at 600 kW(t) with a 1300°F reactor coolant outlet temperature. Nuclear testing of the reactor was conducted over the period from November 22, 1963 to April 15, 1965. The reactor experienced a total of 12,000 hr of operation with 5×10^6 kWh energy release, of which 8760 hr (1 year) were between 400 and 600 kW(t) with coolant outlet temperatures at 1300°F. The S8ER reactor core (fuel elements, internal reflectors, grid plates, and pressure vessel) was shipped as a unit to the Atomics International Hot Laboratory in the summer of 1965, and was disassembled and examined over a period of ~12 months. Inspection revealed that the claddings on 80% of the 211 fuel elements were cracked; even with this condition, the reactor met or exceeded all test objectives. Detailed examinations and analyses showed the cracks to be primarily the result of phase transformation associated swelling of the hydride fuel, coupled with a loss of ductility in the Hastelloy N cladding. This loss of ductility is characteristic of nickel-based alloys at SNAP 8 operating conditions. Analysis of the results of the postirradiation examination indicated that fuel element design must allow sufficient internal clearance between the fuel and the cladding to minimize strain in the cladding. Improved fuel element design, with increased internal clearances to accommodate fuel swelling and an improved hydrogen-retention ceramic barrier to prevent undesirable fuel phase transformation, will eliminate this cladding fracture problem. Reactor operating procedures, aimed at minimizing temperature cyclic conditions and severe temperature transients on the elements which contributed to the S8ER cladding fracture problem, are recommended for long-term operation of such elements. (auth)

10103 (NAA-SR-12378) SNAP REACTOR IMPROVEMENT PROGRAM. Progress Report, January–March 1967. Maki, L. M. (Atomics International, Canoga Park, Calif.). 19 May 1967. Contract AT(11-1)-Gen-8. 51p. Dep. NTIS $4.75.
Declassified 3 May 1973.
Progress in analytical and developmental studies aimed at improving the performance capabilities of SNAP reactors is reported. The studies include reactor physics analysis, fuel development, and component development. (JWR)

10104 (NAA-SR-Memo–6924) SNAP 8 REACTOR AND SHIELD SPECIFICATIONS FOR USE IN SNAP 8 SPACECRAFT DESIGN STUDIES. (Atomics International, Canoga Park, Calif.). 8 Dec 1961. Contract AT(11-1)-Gen-8. 37p. Dep. NTIS $4.00.
Declassified 24 May 1973.

10105 (NAA-SR-Memo-7376) SNAP 8 REACTOR DEVELOPMENT PLAN. Johnson, C. E. (Atomics International, Canoga Park, Calif.). 9 Jul 1962. Contract AT(11-1)-GEN-8. 55p. Dep. NTIS $4.75.
Declassified 3 May 1973.
SNAP 8 reactor, which evolved from SNAP-2 and utilizes SNAP 2 reactor analysis, component development data, and reactor operating data, is described. The reactor is designed for a 60 kW(e) (thermal requirement of 600 kW(t)) system. The nuclear system is designed for 10,000 hr endurance, starting in orbit on ground command and withstanding 50 starts. NaK is used as the coolant and a lithium hydride shadow shield is employed. The reactor is fueled with $(UZr)H_x$ and is coupled to a power conversion system which utilizes a Hg Rankine cycle turbo alternator. Layout drawings for the SNAP 8 reactor and shield are given and a comparison of the key design parameters of SNAP 8 and SNAP 10 is presented. (FS)

10106 (NAA-SR-Memo–8679) SNAP 10A REACTOR DESIGN SUMMARY. Susnir, J.; Harman, T. (eds.). (Atomics International, Canoga Park, Calif.). 5 Dec 1963. Contract AT(11-1)-GEN-8. 86p. Dep. NTIS $6.50.

Declassified 17 Apr 1973.

A description of the SNAP 10A reactor subsystem is presented. Design details of the principal assemblies which constitute the reactor subsystem are discussed. System behavior for abnormal conditions such as disassembly during reentry, operation in rain-filled craters, and long-term operation in space are included. (auth)

10107 SEAMEN TRAINING FOR THE NUCLEAR SHIP MUTSU. Sasaki, S. (Japan Nuclear Ship Development Agency, Tokyo). Nucl. Eng. Int.; 18: No. 204, 409-410(May 1973).

An outline is given of the training of officers and engineers to man the first Japanese nuclear ship Mutsu. This consisted of fundamental training in theory and practice of various nuclear sciences, field training, and simulator training. (UK)

10108 APPLICATIONS OF NUCLEAR REACTOR POWER SYSTEMS TO ELECTRIC PROPULSION MISSIONS. Schaupp, R. W. (Office of Advanced Research and Tech., Moffett Field, CA); Sawyer, C. D. pp 1-12 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

The performance of nuclear electric propulsion systems (NEP) has been evaluated for a wide variety of missions in an attempt to establish the commonality of NEP system requirements. Emphasis was given to those requirements and system characteristics that serve as guidelines for current technology development programs. Various interactions and tradeoffs between NEP system and mission parameters are described. The results show that the most significant factors in selecting NEP system size are launch mode (direct or spiral escape) and launch vehicle capability. Other factors such as mission, payload, and thrust time constraints, have little influence, thus allowing one NEP system to be used for many missions. The results indicated that a 100 kW(e) NEP would be suitable for most direct escape missions and a 250 kW(e) NEP system would be suitable for more demanding missions that use the spiral escape mode. (auth)

10109 MISSION OPERATIONS FOR UNMANNED NUCLEAR ELECTRIC PROPULSION OUTER PLANET EXPLORATION WITH A THERMIONIC REACTOR SPACECRAFT. Spera, R. J.; Prickett, W. Z.; Garate, J. A.; Firth, W. L. (General Electric Co., Valley Forge, PA). pp 13-23 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Mission operations are presented for comet rendezvous and outer planet exploration NEP spacecraft employing in-core thermionic reactors for electric power generation. The selected reference missions are the Comet Halley rendezvous and a Jupiter orbiter at 5.9 planet radii, the orbit of the moon Io. The characteristics of the baseline multi-mission NEP spacecraft are presented and its performance in other outer planet missions, such as Saturn and Uranus orbiters and a Neptune flyby, are discussed. Candidate mission operations are defined from spacecraft assembly to mission completion. Pre-launch operations are identified. Shuttle launch and subsequent injection to earth escape by the Centaur D-1T are discussed, as well as power plant startup and the heliocentric mission phases. The sequence and type of operations are basically identical for all missions investigated. (auth)

10110 THERMIONIC REACTOR SYSTEM FOR AUXILIARY POWER AND ELECTRIC PROPULSION. Fisher, C. R.; Gietzen, A. J.; Hackney, M. R.; Heath, C. A.; Homeyer, W. G.; Ingber, J. F.; Merrill, M. H. (Gulf General Atomic, Inc., San Diego, CA). pp 24-33 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Thermionic reactor power system designs have been studied for both manned and unmanned missions with power levels from 5 to 120 kW(e). All reactor designs apply the six-cell thermionic fuel element of which prototypes are now being operated in the Gulf General Atomic Company thermionic test reactor. Two reactor types have been studied: a moderated reactor containing U-ZrH driver fuel elements in addition to thermionic fuel elements for the lower power levels; and at the 120 kW(e) level, a fast spectrum reactor with only thermionic fuel elements. The three specific applications for which power system designs are presented are auxiliary power for a growth version (12 to 20 men) of a modular space station requiring up to 50 kW(e), unmanned electric propulsion missions requiring 120 kW(e), and unmanned satellites requiring power levels of 5 to 10 kW(e). Design parameters are given for the two types of core designs, moderated and fast spectrum, and two types of vessel designs, for manned and unmanned applications. Data on the systems include electrical and thermal performance parameters, weights, and dimensions. (auth)

10111 EXTERNAL FUEL THERMIONIC REACTOR SYSTEM. Mondt, J. F.; Peelgren, M. L. (California Inst. of Tech., Pasadena). pp 34-40 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Thermionic reactors are prime candidates for nuclear electric propulsion. The national thermionic reactor effort is concentrated on the flashlight concept with the external-fuel concept as the backup. The external-fuel concept is very adaptable to a completely modular power subsystem which is attractive for highly reliable long-life applications. The 20- to 25-cm long, externally fueled converters have been designed, fabricated, and successfully tested with many thermal cycles by electrical heating. However, difficulties have been encountered during encapsulation for nuclear heated tests and none have been started to date. These nuclear tests are required to demonstrate the concept feasibility. (auth)

10112 COMPARISON OF CLOSED LOOP THERMIONIC REACTOR CONTROL SCHEMES. Sawyer, C. D. (California Inst. of Tech., Pasadena). pp 41-51 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

The dynamics of the constant-voltage and constant-emitter-temperature control schemes are described. The closed loop responses to load changes, converter failures and reactivity perturbations are shown. Both control schemes inherently allow load voltages to vary during transients. An alternative control scheme is proposed which allows constant load voltage while preserving constant emitter temperatures. (auth)

10113 THERMIONIC REACTOR POWER CONDITIONER DESIGN FOR NUCLEAR ELECTRIC PROPULSION. Jacobsen, A. S.; Tasca, D. M. (General Electric Co., Valley Forge, PA). pp 52-58 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Consideration of the effects of various thermionic reactor parameters and requirements upon spacecraft power conditioning design are presented. A basic spacecraft is defined using nuclear electric propulsion requiring approximately 120 kW(e). The interrelationships of reactor operating characteristics and power conditioning requirements are discussed and evaluated, and the effects on power conditioner design and performance are presented. (auth)

10114 THERMIONIC FUEL ELEMENT DEVELOPMENT PROGRAM STATUS. Yates, M. K.; Holland, J. W.; Allen, D. T.; Fitzpatrick, G. O.; Grebetz, J. C.; Horner, M. H. (Gulf General Atomic, Inc., San Diego, CA). AT(04-3)-840. pp 68-77 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Review of a thermionic fuel element (TFE) development program which has been in progress since 1962 is presented. The first TFEs (E Series) were a direct outgrowth of single-cell development and consisted of two cells welded together and bonded into a sheath tube. The present fuel elements (F Series) are the prototypes for a thermionic reactor experiment and for the flight system and are based on the E Series design. The full-length fuel element consists of six cells welded together and bonded into a sheath tube. One and two cell versions were also designed. Three E Series TFEs were fabricated; the fabrication of the F Series TFEs has progressed to the point where 27 F Series cells have been completed. These have been assembled thus far into three six-cell TFEs, one two-cell TFE, and three one-cell TFEs. Five of these fuel elements are presently on test in a thermionic test reactor. Of the F Series, one full-length TFE, 6F1, and one one-cell TFE, 1F2, have accumulated more than 1000 hours each. One one-cell TFE, 1F1, has accumulated more than 200 hours. Of the E Series, one, 2E1, has accumulated over 9700 hours, and one, 2E2, over 200 hours. (auth)

10115 DESIGN OF AN EXTERNAL-FUELED THERMIONIC DIODE FOR IN-PILE TESTING. Ernst, D. M. (Thermo Electron

Corp., Waltham, MA); Peelgren, M. L. pp 78-85 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Description of an external-fueled thermionic diode suitable for in-pile testing in a research reactor is presented. The active electrode area is 94 sq cm. The 10-in. long, 1.5-in.-OD emitter body is tungsten 2% thoria. The fuel is contained in six 0.4-in.-diam holes equally spaced about the 0.5-in. central emitter hole. The collector is niobium-1% zirconium. The expected diode performance is 6 W/sq cm at 2000°K. In addition to following the constraints imposed by the in-pile testing and the electrically heated performance mapping prior to insertion in-pile, the diode will have end configurations prototypical of those anticipated for a flow-through, NaK-cooled, external-fuel thermionic reactor. (auth)

10116 DESIGN AND TESTING A HIGH FUEL VOLUME FRACTION, EXTERNALLY FINNED, THERMIONIC EMITTER. Peelgren, M. L. (California Inst. of Tech., Pasadena); Ernst, D. M. pp 86-91 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

A prototypical, high fuel volume fraction, thermionic emitter body was designed and tested. The emitter body is all tungsten, with a 1.40-cm ID, a 3.23-cm OD, and eight full-length axial fins. The emitter thickness is 0.15 cm while the fins and outer clad are 0.075 cm thick. Different methods of fabrication were used in making the test samples. Stress analysis was performed with a three-dimensional elastic code. Thermal testing of the samples, duplicating calculated radial temperature gradients, heatup and cooldown rates, and emitter body temperatures in operation, was performed with no structural failures noted (six heatup and cooldown cycles per sample). (auth)

10117 SIZING AN EXTERNAL-FUELED IN-CORE THERMIONIC REACTOR. Nakashima, A. M.; Sawyer, C. D. (California Inst. of Tech., Pasadena). pp 99-109 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Parametric studies on sizing of external-fueled in-core thermionic reactors are presented. Reactor physics results obtained for a variety of fuel element designs are used as a basis for nuclear criticality, power distribution, and control worth design. Thermionic performance results for a single fuel element for several sets of operating conditions are presented. An algorithm combining the electrical and reactor physics results in a form amenable to preliminary systems analysis is presented. (auth)

10118 REACTOR CORE LENGTH, EXTERNALLY CONFIGURED THERMIONIC CONVERTER. Shimada, K.; Rouklove, P. (California Inst. of Tech., Pasadena). pp 110-115 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Results of testing a converter having an external emitter configuration for 190 hours using RF induction heating are presented. The converter was assembled with a rhenium emitter, 25.4 cm long, having a 91.2 sq cm emitting area, and a niobium collector with a molybdenum coating to improve its electronic property. The collector was water-cooled. The test included: static power output measurements, dynamic characteristics, and the effects of the temperature distribution along the emitter. The maximum power output achieved from the converter at an emitter temperature of 1942°K was 178 W at 0.48 V output, with a power density of 1.95 W/sq cm and an efficiency of 5.5%. The static characteristics also indicated that, with a constant power input, the converter power output does not vary with the output voltage as a result of self-adjustment of the emitter temperature. An investigation of the effects of the temperature distribution along the emitter length showed a 33% improvement in the converter output power with a flattening of the emitter temperature. (auth)

10119 DEVELOPMENT OF A FULL-LENGTH EXTERNAL-FUEL THERMIONIC CONVERTER FOR IN-PILE TESTING. Schock, A.; Raab, B. (Fairchild Industries, Inc., Farmingdale, NY). pp 116-127 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Description of an external-fuel thermionic converter which utilizes a thoriated-tungsten fuel-emitter body is presented. Performance in out-of-pile tests was comparable to that of an arc-cast tungsten emitter body, with 400-W(e) output power (about 5 W/sq cm) at 10.8% efficiency. Maximum fuel clad temperature averaged from 1650 to 1700°C during the 300-hour test. This converter has been processed for in-pile testing. The various processing steps, including the installation of six emitter thermocouples, encapsulation in the secondary container, and joining to the fission-gas collection system, are described in detail. In addition to the converter assembly, a doubly contained fission gas collection assembly with radiation-hardened differential pressure transducers was fabricated. The experiment support plate required for the in-pile test, containing electrically insulated instrumentation feedthroughs and coolant line feedthroughs to the vacuum test chamber, was also fabricated. (auth)

10120 IMPLICATIONS OF CERAMIC-INSULATOR IRRADIATION RESULTS FOR THERMIONIC REACTOR DESIGN. Frank, T. G. (Los Alamos Scientific Lab., NM); Ranken, W. A.; Backus, C. E. pp 133-136 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionics conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

All the data on neutron-irradiation damage to alumina insulators to data indicate that the use of alumina in thermionic-reactor construction will be a lifetime-limiting factor. However, recent developments in understanding the effects of various neutron spectra on the damage to alumina have permitted the placing of realistic limits on values of neutron fluence that are compatible with a high probability of survival of thermionic-reactor fuel elements. The effects on neutron damage to insulators of the inclusion of hydrogenous moderating material in thermionic reactor cores have been calculated. The results are presented in terms of relative insulator damage as functions of the amount of moderating material included in various thermionic-reactor core designs. (auth)

10121 DIELECTRIC BREAKDOWN IN ELECTRICAL INSULATORS USED IN THERMIONIC CONVERTERS. Britt, E. J.; Davis, M. V. (Univ. of Arizona, Tucson). pp 137-146 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Theoretical investigation of the phenomena of dielectric breakdown in alumina and beryllia for a range of temperatures extending from 300 to 1200°K is presented. A theoretical model which encompasses two different types of breakdown processes was developed. Each part of the theory specifies the critical prebreakdown conditions and the mechanism which leads to failure for different parts of the temperature regime. The breakdown model was combined with a general energy-band model for an insulator with localized trapping centers. The effects of carrier generation with radiation and field enhancement, trapping, collision multiplication, and recombination are all considered. Both dielectric breakdown caused by an electron avalanche and thermal breakdown which occurs at higher temperatures are considered. (auth)

10122 DEVELOPMENT OF THE INSULATING MULTILAYER COLLECTOR SYSTEM FOR ITR. Status Report. Peehs, M.; Schoerner, H. (Siemens AG, Erlangen, Ger.). pp 147-154 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Review of some of the results of an ongoing investigation of the merits of alternative technological approaches to the manufacture of the insulating multilayer collector system to be used in the fuel elements of the in-core thermionic reactor under development is presented. The manufacturing processes reviewed include plasma spraying of aluminum oxide, stretchforming, magnetic forming, chemical vapor depositing, aluminum oxide fusing, annular gap moulding, fusion baking, and press-fitting of aluminum oxide sleeves. The technological problems encountered in the machining and outgassing of niobium are discussed, along with the electrical and thermal test procedures used and to be used. (IAA)

10123 RADIATION DAMAGE TO REFRACTORY METALS AS RELATED TO THERMIONIC APPLICATIONS. Wiffen, F. W. (Oak Ridge National Lab., TN). pp 156-165 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

The effects of fast neutron irradiation on the body-centered cubic

refractory metals are reviewed with emphasis on materials and conditions typical of thermionic applications in space power systems. Changes produced in the microstructure are characterized as a function of irradiation temperature. The effects of fluence, alloying, and purity are examined where data are available. Swelling and changes in the mechanical and electrical properties produced by neutron irradiation are briefly reviewed. The major effects expected are in the collector and cooler portions of the emitter in a thermionic diode where swelling, electrical resistivity increases, and ductility losses are anticipated during reactor operation. (auth)

10124 FABRICATION AND TESTING OF TUNGSTEN HEAT PIPES FOR HEAT PIPE COOLED REACTORS. Bacigalupi, R. J. (Lewis Research Center, Cleveland). pp 166-169 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

The choice of chemically vapor deposited (CVD) tungsten as material for the heat pipes is based on studies reported by Busse. Aspects of pipe construction are discussed together with wick construction, and heat pipe operation. An auxiliary heater was used to overcome problems during the start of operation in the case of a thermally loaded pipe. Two heat pipes were operated at temperatures up to 1850°K. Annular and channeled wicks were investigated. The design of a cross flow heat exchanger is presented together with the design of a reactor heat pipe life test station. (IAA)

10125 TECHNOLOGY AND TESTING OF THE EMITTER-FUEL-SYSTEM FOR ITR. Peehs, M.; Schoerner, H. (Siemens AG, Erlangen, Ger.). pp 313-322 of Annual Thermionic Conversion Specialist Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1971).

From IEEE thermionic conversion specialist conference; San Diego, California, USA (4 Oct 1971). See CONF-711038--.

Review of the technology of the high-temperature-components of the in-core thermionic reactor presently under development is presented. These components consisting of the thermionic fuel elements make up the emitter fuel system. Therein, molybdenum is to be used as the structural material and uranium dioxide as the fuel. The discussion of the molybdenum technology includes the turning, milling, grinding; normal, spark-erosion, electrochemical, deep-hole, and normal drilling, and otherwise machining; degassing, electron-beam welding, and tungsten coating by tungsten carbonyl pyrolysis. Following a review of the stoichiometry and degassing of the uranium dioxide, the molybdenum–tungsten interdiffusion is examined. In-pile and out-pile testing experiments are briefly surveyed. (IAA)

10126 EVALUATION OF RESEARCH AND DEVELOPMENT. Newby, D. J. Brit. Nucl. Energy Soc.; 12: No. 2, 241-251(Apr 1973).

The Programs Analysis Unit was established to explore the wider applicability of appraisal techniques to civil research and development programs. The work that the unit has undertaken in this field is described and its working methods are outlined. The examination and application of these techniques within the unit are discussed, and an evaluation of the various techniques of technological forecasting when used on real problems is attempted. The determination of the criteria on which to judge research programs is also noted. The methodology employed in the evaluation of a particular research and development program has to be suited to the program and the data available. The implied constraints are questioned, alternative practical goals explored, and alternative routes investigated before the end product can be fully examined. The costs of this end product, the markets available, and the manner of exploitation may then be assessed. The benefit of the R and D program may then be established. Examples of the work carried out in the unit are selected to illustrate the application of the techniques described to practical cases. A nuclear ship study carried out in 1970 shows the process of harmonization of estimates of future reactor costs prepared on different bases, and work from a study on fuel cells illustrates other aspects of the techniques described. (auth)

10127 PERSPECTIVES OF THE APPLICATION OF NUCLEAR PROPULSION FOR MERCHANT SHIPS. David, Y.; Lefebvre de Ladonchamps, J. Bull. Ass. Tech. Mar. Aeronaut.; No. 69, 61-82 (1969). (In French).

After a preliminary discussion of the application of nuclear propulsion to merchant ships, the authors undertake an analysis of the economics of nuclear-powered merchant ships in 1968 and 1985, using clearly stated assumptions about the cost and weight of power plants for both conventional and nuclear vessels. They conclude that nuclear propulsion is not currently economic for commercial vessels but may become competitive in the 1980's for vessels of large size requiring power in excess of approximately 100,000 horsepower. They point out that errors in their cost projections for 1985 could invalidate these conclusions. A discussion in which the assumptions are examined critically and skeptically is included. (App. Mech. Rev.)

Reactor Safety and Environmental Aspects

Refer also to abstracts 8132, 8134, 8136, 8137, 8175, 8177, 8182, 8396, 8405, 9956, and 10383.

10128 (CONF-730304--) TOPICAL MEETING ON WATER-REACTOR SAFETY, SALT LAKE CITY, UTAH, MARCH 26-28, 1973. Freund, G. A. (Comp.) (Aerojet Nuclear Co., Idaho Falls, Idaho). 1973. 781p. Dep. NTIS $13.60.

Information on water-reactor safety is presented under the following headings: accident analysis and probability; fluid flow during LOCA; mechanical behavior of materials; heat transfer during LOCA; standards and surveillance; computer codes and applications; protection from natural and man-made phenomena; and comparative analysis of LOCA. Separate abstracts are included for 31 of the 45 papers presented. Fourteen of the papers have been previously abstracted and included in NSA. (DCC)

For abstracts of individual papers see: 10129–10159.

10129 (CONF-730304-, pp 1-15) ASSESSMENT OF RISK IN REACTOR SAFETY. Jacobs, I. M. (General Electric Co., San Jose, CA). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The methodology used to assess the risk to the public due to transients and accidents in nuclear power plants is described. Probabilistic techniques are described that facilitate realistic representation of the problem and allow all pertinent data to be utilized in the solution. The variability and uncertainty inherent in many parameters is readily accommodated. The significant results from three of the so-called design basis accidents are reported. The fuel handling accident and the loss-of-coolant accident have trivial consequences compared to the dose the public receives from natural background radiation. The control rod drop accident, due to its extremely low probability of occurrence, is less significant than either of the other two accidents. 10 references. (auth)

10130 (CONF-730304-, pp 16-38) FACTORS INFLUENCING A QUANTITATIVE SAFETY ASSESSMENT OF WATER REACTOR PRESSURE VESSELS. Witt, F. J. (Oak Ridge National Lab., TN). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The assessment of the potential of fracture, bursting or leakage, of water reactor pressure vessels requires a technology capable of making quantitative engineering calculations of fracture conditions and a realistic, accurate or conservative procedure for obtaining the parameters necessary for making the calculations. Most facets of both these requirements are being met by research sponsored by the USAEC's Heavy-Section Steel Technology (HSST) Program. The factors affecting fracture in the context of applicability to water reactor pressure vessels are discussed. On the basis of available information, it is concluded that there is practically no possibility of fracture of the subject vessels for normal startup, operating, and cool-down conditions. Abnormal conditions require additional evaluations, but it is extremely unlikely that any such could actually lead to fracture for reasonable flaw sizes. 21 references. (auth)

10131 (CONF-730304-, pp 39-63) FULL-SCALE CONTAINMENT EXPERIMENTS PERFORMED IN THE MARVIKEN POWER PLANT. Thoren, H. G.; Ericson, L.; Hesboel, R.; Brandt, W. (Aktiebolaget Atomenergi, Nykoping, Sweden). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The full scale containment experiments, being carried out as a multinational project in the Marviken power plant, are presented. Brief descriptions of the test facility, measurement equipment, programs of the blowdown tests and of the studies of iodine transport, containment leakage and component response performed in conjunction with the blowdown tests are presented. A short de-

scription of the preparations and the procedure of the tests is also given. As the test data obtained have not, as yet, been finally analyzed only some illustrative responses of the PS-containment to the simulated blowdowns are presented. (auth)

10132 (CONF-730304-, pp 84-109) PROBABILITY OF DAMAGE TO NUCLEAR COMPONENTS DUE TO TURBINE FAILURE. Bush, S. H. (Battelle Pacific Northwest Labs., Richland, WA). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The probability of significant damage to critical components of a nuclear reactor system due to turbine failure has been assessed by determining the combined probabilities of turbine failure and ejection of an energetic missile (P_1), based on 70,000 turbine years of operation, a missile from the turbine striking a critical component (P_2), and significant damage occurring to the component (P_3). The overall probability (P_4) is an indication of how much the nuclear plant designer needs to be concerned with the turbine missile problem. Turbine failures were reviewed to establish relevance with regard to current practice in design, fabrication and operation of nuclear steam turbines. If P_1 is 10^{-4}/yr, P_2 is 10^{-3} for strike on a 1200 ft^2 area, and $P_3 \rightarrow 1$, then P_4 is approximately 10^{-7}. If P_2 increases, evaluation of P_3 becomes necessary. 16 references. (auth)

10133 (CONF-730304-, pp 110-122) ANALYSIS OF A PWR SYSTEM FOR A COMPLETE LOSS OF FEEDWATER ACCIDENT WITHOUT REACTOR TRIP. Rose, R. P.; Cooper, K. F. (Westinghouse Nuclear Energy Systems, Pittsburgh). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

Recent attention has been directed toward the consequences of anticipated water reactor system transients, as defined by ANS Standard ANS 4.1, with the additional constraint that the transient is not terminated by a reactor trip. Analysis of the accident which produces the maximum primary system over-pressure transient, a complete loss of main feedwater to all steam generators without reactor trip, is presented. It is concluded that the likelihood of not tripping the reactor is sufficiently small so that no consideration of the consequences of this transient should be considered in the system design. For the complete loss of main feedwater transient where the transient is terminated by the reactor protection system, the primary system pressure is limited to 2500 psia. Assuming that the reactor is not tripped, the primary system pressure is limited to 3000 psia by the safety valves and reactor control systems. If reactor trip results in dropping only some of the control rods into the core, 0.8% negative reactivity is shown to limit the peak primary system pressure to 2500 psia for the worst time in core life. 5 references. (auth)

10134 (CONF-730304-, pp 123-135) CONTROL ROD EJECTION TRANSIENT IN A PRESSURIZED WATER REACTOR. Risher, D. H. Jr. (Westinghouse Nuclear Energy Systems, Pittsburgh). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The rod ejection accident is analyzed using the adiabatic or instantaneous tilt approximation. In this method the ejected rod worth and power distribution after ejection is obtained from a multidimensional static calculation with zero feedback. A one-dimensional kinetic analysis is used to obtain the nuclear power transient, representing the average channel in the core. A three-dimensional transient analysis was performed to test the conservativeness of the method described above. It is evident that with the "adiabatic" method: the overprediction of the ejected rod worth and underprediction of the feedback leads to a conservative prediction of the average core energy release compared to a three-dimensional calculation; and the use of the overpredicted hot channel factor in the hot spot calculation leads to a further conservative prediction of the hot spot energy release and consequently in the maximum fuel and clad temperatures. (auth)

10135 (CONF-730304-, pp 136-151) SMALL BREAK LOSS-OF-COOLANT ACCIDENT. Longo, J. Jr.; Kern, R. C. (Combustion Engineering, Inc., Windsor, CT). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The blowdown phenomena associated with a small break loss-of-coolant accident in a pressurized water reactor have been studied with computer simulation. The results of the analysis indicate that: hydrostatic forces influence the core cooling capabilities during blowdown; the use of a single-node blowdown model is inadequate; correct modeling of the plant physical hardware is important; and caution must be exercised in modeling the annulus region of the reactor vessel within the context of currently used phase-separation models. (auth)

10136 (CONF-730304-, pp 152-171) PRESSURIZED WATER REACTOR LOSS-OF-COOLANT ACCIDENTS BY HYPOTHETICAL VESSEL RUPTURE. Doan, P. L.; Lanning, D. D.; Rasmussen, N. C. (Massachusetts Inst. of Tech., Cambridge). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The unlikely loss of coolant by some types of postulated pressure vessel rupture in a large, 4-loop, 2758 MW(t) pressurized water reactor plant has been studied with the objective of probing the relative importance and consequences of principal blowdown processes. The computer codes WHAM and RELAP 3 have been employed as the principal tools of analysis. A large number of computer runs have been made with varying parameters such as break time, break location, break size, fuel-clad gap conductance, ECC injection modes, void coefficients and phase separation models. Clear patterns are observed on the asymptotic behavior of many blowdown parameters. 15 references. (auth)

10137 (CONF-730304-, pp 172-195) BLOWDOWN FLOW RATES OF INITIALLY SATURATED WATER. Simon, U. (AEG-Telefunken, Frankfurt am Main). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

Different models have been proposed for calculating the maximum mass flow rate of saturated water. These are discussed and compared with experimental data of various authors. The experiments show a considerable effect of the nozzle geometry on the value of the critical mass flow rate. The theory assuming retarded vapour formation during expansion correctly predicts the effect of nozzle length, but not of nozzle diameter. A flow chart is proposed in regard to the experimental data, showing ranges of nozzle geometry where different physical effects should be considered in a theory predicting the maximum mass flow rate. 36 references. (auth)

10138 (CONF-730304-, pp 196-211) EXPERIMENTAL EVALUATION OF POST-LOCA STEAM VENTING. Lowe, P. A.; Burchill, W. E.; Brodrick, J. R. (Combustion Engineering, Inc., Windsor, CT). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The test program and experimental results of the interaction of steam and emergency core cooling (ECC) water within a model of the cold leg piping of a pressurized water reactor are described. The program background and objectives are presented. The test apparatus and testing techniques are discussed. Data from a 1/5 scale model of the broken and intact cold leg piping configurations are presented in detail. Initial results from 1/3 scale testing are also discussed. 3 references. (auth)

10139 (CONF-730304-, pp 254-273) HIGH TEMPERATURE EXPANSION AND RUPTURE BEHAVIOUR OF ZIRCALOY TUBING. Hardy, D. G. (Chalk River Nuclear Labs., Ont.). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The high temperature strain and rupture behavior of Zircaloy-4 tubing was investigated. The tubing employed was of a size used as fuel cladding in the Pickering heavy water reactors. Mechanical property data are presented in graphical form covering a range of values of interest in loss-of-coolant accident studies. The effects of internal pressure and heating rate were studied in the transient-temperature tests, and the effects of internal pressure and temperature were studied in the stress-rupture tests. The α to β transformation was found to have a significant effect on the results. The Pickering data are compared with published results obtained on BWR and PWR tubing. 7 references. (auth)

10140 (CONF-730304-, pp 289-312) REACTOR PRIMARY COOLANT PIPE RUPTURE STUDY. Kiss, E. (General Electric Co., San Jose CA). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The objectives and recent accomplishments of the various tasks of the Reactor Primary Coolant Pipe Rupture Study are presented. Technical areas covered include investigation of ASME low cycle fatigue design rules and fatigue evaluation of prototype pipe com-

ponents, evaluation of the effects of a BWR environment on the low cycle fatigue of three nuclear piping materials, and a brief discussion of two methodologies developed for the purpose of estimating the probability of leak or break in a piping system. 62 references. (auth)

10141 (CONF-730304-, pp 321-350) POST-DRYOUT HEAT TRANSFER AT REACTOR OPERATING CONDITIONS. Groeneveld, D. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

Post-dryout heat transfer data from various laboratories were analyzed. Most data were obtained in directly heated tubes and annuli; an empirical heat transfer correlation was derived for these geometries. A semi-theoretical prediction method was found to agree with the tube data and the correlation. It was not found possible to derive a post-dryout correlation based on available bundle data (which included data from four in-reactor experiments). The bundle data were compared with predictions from the empirical correlation (based on tube and annuli data); agreement was best at axial locations in the bundle where most of the rods were in dryout. Post-dryout experiments on roughened heaters showed that small roughness elements can reduce post-dryout temperatures considerably. In the annular flow regime this could be accompanied by a reduction in critical heat flux. 102 references. (auth)

10142 (CONF-730304-, pp 351-370) COOLING MECHANISM OF THE LOW PRESSURE COOLANT INJECTION SYSTEM OF BOILING WATER REACTORS AND OTHER STUDIES ON THE LOSS-OF-COOLANT ACCIDENT PHENOMENA. Ogasawara, H. (Hitachi Ltd., Japan); Kashiwai, S.; Naitoh, M.; Yamanouchi, A.; Takashima, Y. 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

Flooding technique, in conjunction with spray cooling, is included in emergency core cooling systems (ECCS) of boiling water reactors (BWR's). Effectiveness of flooding was tested with a full scale BWR fuel bundle simulator over range of loss-of-coolant accident (LOCA) conditions. Test results are summarized. 13 references. (auth)

10143 (CONF-730304-, pp 397-415) APPLICATION OF IEEE CODES AND STANDARDS. Test, L. D. (General Electric Co., San Jose, CA). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The use of recent IEEE standards in designing reactor protection systems for water reactors is discussed. Specifically, the role of IEEE 279, "Criteria for Protection Systems for Nuclear Power Generating Stations," is described and its contents analyzed to show how it can serve as a check list for protection system design. This analysis starts with the definition and general requirements of the reactor protection system and then moves into the details of the design requirements. 21 references. (auth)

10144 (CONF-730304-, pp 416-425) APPLICATION OF MECHANICAL AND STRUCTURAL CODES AND STANDARDS IN THE DESIGN OF WATER REACTOR SAFETY SYSTEMS. Keever, R. E.; Pashos, T. J. (Nuclear Services Corp., Campbell, CA). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

A brief summary of the codes and standards currently being applied in the design of nuclear plant structures and mechanical components and systems is presented. In addition, some of the codes and standards under development by the nuclear industry are identified. (auth)

10145 (CONF-730304-, pp 426-449) STATE OF THE ART OF NOISE ANALYSIS IN POWER REACTORS. Uhrig, R. E. (Univ. of Florida, Gainesville). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The application of noise techniques to the analysis of the behavior of nuclear power reactors is described. Safety related measurements and surveillance procedures dealing with vibration, boiling, stress wave emission, control during normal operation, and malfunction detection are discussed. Noise techniques used to develop and verify models of nuclear power systems are also described. 17 references. (auth)

10146 (CONF-730304-, pp 450-479) EEI-TVA ACOUSTIC EMISSION PROGRAM RESULTS. Reinhart, E. R.; Jolly, W. D. (Southwest Research Inst., San Antonio). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

A prototype acoustic emission system for evaluation under simulated reactor operating conditions is described. Experimental results of operation of the prototype system on the Experimental Beryllium Oxide Reactor (EBOR) vessel, modified to simulate a light water reactor, at elevated temperature and in the presence of simulated reactor coolant flow noise, indicate that on-line reactor surveillance is feasible. A successive approximation triangulation technique and a coincident detection location technique were evaluated. The coincident detection location technique was used to locate simulated emission sources at a signal-to-noise amplitude ratio of −12 dbV. Fatigue cracks grown from the inner and outer surface of the EBOR pressure vessel exhibited similar acoustic emission response. These results all tend to show that this technique, when properly utilized, could be a powerful supplement to existing in-service inspection methods. 16 references. (auth)

10147 (CONF-730304-, pp 480-500) ACOUSTIC EMISSION MONITORING SYSTEMS FOR PRIMARY SYSTEM SURVEILLANCE. Gopal, R. (Westinghouse Nuclear Energy Systems, Pittsburgh); Ross, C. J. 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

Some background in acoustic emissions, recent advances in instrumentation for detecting severe environmental acoustic emission, results of acoustic emission measurements, the measurements taken on the Prairie Island Unit No. 1 Vessel, and areas of future endeavor are presented. 5 references. (auth)

10148 (CONF-730304-, pp 501-515) CAN MACRO-MICRO-TYPE FLOW COMPUTATION SCHEMES BE REACTOR ENGINEERING TOOLS? Esposito, V. J.; Spencer, A. C. (Westinghouse Nuclear Energy Systems, Pittsburgh). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

Three broad classifications of mathematical analyses for modeling reactor system flows are examined. One of the three, the Macro-Micro Model, is shown to be the approach best suited for analyzing detailed flows within reactor system components. 9 references. (auth)

10149 (CONF-730304-, pp 537-551) SIMULATION OF PRESSURE DISTRIBUTIONS AND STEAM FLOW PROCESSES DURING THE ECC LOW PRESSURE AND REFILLING PHASE OF A PWR. Brosche, D.; Grosserichter, R. (Technische Univ., Munich). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The simulation of pressure distributions and of the flow behavior in the primary system of a pressurized water reactor (PWR) during the low pressure and refilling phase of emergency core cooling (ECC) after a loss-of-coolant accident with a new computer code is treated. The mathematical model of the code is described and some calculational results are shown which demonstrate the influence of different parameters on the pressure distribution within the whole system and therefore on the core reflooding rates. 10 references. (auth)

10150 (CONF-730304-, pp 581-607) ELEMENT-ASSOCIATED DAMPING BY MODAL SYNTHESIS. Koss, P. (Bechtel Power Corp., Los Angeles). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

When nuclear power plant structures are subjected to seismic loading, individual components and substructures exhibit pronounced differences in dynamic behavior. A typical analytical model may consist of a discretized representation of the soil media (low elastic modulus, high damping), the containment shell (intermediate modulus, moderate damping), and the nuclear steam supply system (high modulus, low damping). Inasmuch as classical modal techniques are invalid for describing the damping characteristics of such a system, a number of rule-of-the-thumb procedures have been proposed. Utilizing matrix methods, a more rigorous method for computing the damping matrix for composite systems is presented. Damping matrices for subsystems are combined together utilizing a modal synthesis procedure. A method of relating the more rigorously formulated damping ma-

trix to an equivalent modal damping is presented. Examples of problems are developed to compare and contrast the various procedures for calculating damping. The examples illustrate the need for more rigorous formulation of the damping matrix and that approximate methods may be employed in some cases if conservative input is maintained. 13 references. (auth)

10151 (CONF-730304-, pp 608-622) DAMPING FOR DYNAMIC ANALYSIS OF REACTOR COOLANT LOOP SYSTEMS. Bohm, G. J. (Westinghouse Electric Corp., Pittsburgh). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The behavior of reactor coolant loop components under dynamic loads is normally obtained analytically by assuming that the system has an energy dissipation mechanism which can be represented by equivalent viscous damping coefficients. The results of tests in past experimental work are correlated with the concept of losses due to material and structural damping as well as to the various modes excited. Damping ratio values are proposed for use when dynamic elastic analysis is performed to obtain system response under seismic excitation and loads due to postulated accidents. The dependence of damping values on the magnitude of component response also is discussed. 23 references. (auth)

10152 (CONF-730304-, pp 623-636) SEISMIC INSTRUMENTATION FOR NUCLEAR POWER PLANTS. Kapur, K. K. (Atomic Energy Commission, Washington, DC). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

Seismic designs for nuclear power plants utilize advanced analytical and design techniques. It is important that suitable seismic instrumentation is provided on each nuclear plant to determine promptly the seismic response of nuclear power plant features important to safety to permit comparison of such response with that used as design basis. The type and location of earthquake instrumentation that appears appropriate to provide information on the input vibratory ground motion and resultant vibratory responses of representative seismic Category I structures, equipment and components are discussed. (auth)

10153 (CONF-730304-, pp 637-643) UTILIZING THE PLANT COMPUTER IN PROTECTING AGAINST SABOTAGE AT A NUCLEAR FACILITY. Clark, R. G. (Battelle Pacific Northwest Labs., Richland, WA). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

Recently proposed Federal rule-making for protection against sabotage at nuclear facilities recognizes the need for industrial security to be effective against sabotage that originates from within the plant (disgruntled employees) as well as from outside forces. A safety analysis review of incidents that might be initiated by knowledgeable saboteurs reinforces that need. Experience indicates a system effective against sabotage from within as well as supportive of conventional security systems may be that of utilizing a computer coupled to modern detection and surveillance devices at a nuclear facility. Software would be used for basic decision making, automatic responses and record keeping. This concept would possibly result in a change in the role of the conventional plant security forces. 10 references. (auth)

10154 (CONF-730304-, pp 644-661) HAZARDS TO NUCLEAR PLANTS FROM ON (OR NEAR) SITE GASEOUS EXPLOSIONS. Iotti, R. C.; Krotiuk, W. J.; DeBoisblanc, D. R. (Ebasco Services, Inc., New York). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The formation of a detonation in a gas-air mixture is discussed. The shock wave and ground motion attenuation as a function of the blast energy and the distance to the nearest structure are also presented with recommendations for locations of plant critical structures with respect to possible explosion sources. The hazards to plant areas resulting from explosion generated missiles are also assessed. 20 references. (auth)

10155 (CONF-730304-, pp 662-675) SAFETY CONSIDERATIONS IN THE DESIGN OF MULTI-UNIT NUCLEAR PLANTS. Ebersole, J. C. (Tennessee Valley Authority, Knoxville, TN). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

A multiunit plant, or a multiplant nuclear complex, is identified as an integrated design problem. The flow of influences from common commercial features and systems is identified within the set of challenges to the systems which prevent and mitigate accidents. The idea of integrated systems analysis including influence potentials from common commercial grade equipment and systems is recommended. It is suggested that the principal challenge to nuclear safety may be progressions of small malfunctions which lead to degradation of the decay heat removal systems after reactor trip. (auth)

10156 (CONF-730304-, pp 685-701) COMPARISONS BETWEEN RESULTS OF THE WESTINGHOUSE LOSS-OF-COOLANT ANALYSES AND LOFT SEMISCALE (ECC) TEST DATA. Part I. SATAN-5 Code Results. Khan, M. P. (Westinghouse Electric Corp., Monroeville, PA). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The SATAN-5 digital computer code determines the system dynamic behavior under a variety of conceivable plant transient and accident situations. The conservation equations for transient flow in thermodynamic equilibrium are expressed in finite difference form for a control volume and are integrated numerically in time. The code is used to model LOFT test facility and compare its results with test data for runs 823, 845, 848 and 850. The comparisons are good, when one uses a discharge coefficient of less than 1.0 and with the addition of metal heat from the piping. 7 references. (auth)

10157 (CONF-730304-, pp 702-719) COMPARISONS BETWEEN RESULTS OF THE WESTINGHOUSE LOSS-OF-COOLANT ANALYSES AND LOFT SEMISCALE (ECC) TEST DATA. Part II. BLODWN-2A Code Results. Fabic, S. (Westinghouse Electric Corp., Monroeville, PA). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

The BLODWN-2A code is based on the method of characteristics applicable to transient flow of a homogeneous fluid in thermal equilibrium. The system geometry is represented by a network of one-dimensional flow passages. The two-phase discharge model is based on the solution of the transient momentum equation with the fluid velocity set equal to local sonic velocity. Comparisons of the code results and test data are good, except for an overprediction of the depressurization rate at the tail end of the transient and the failure to predict the observed density spikes in the vicinity of the point of attachment of the pressurizer line. 6 references. (auth)

10158 (CONF-730304-, pp 720-739) SOME UK STUDIES RELATED TO THE LOSS-OF-COOLANT ACCIDENT. Edwards, A. R.; Mather, D. J. (Safety and Reliability Directorate, Culcheth, Eng.). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

With increasing emphasis on the use of complex computer codes, it is essential to appreciate the limitations imposed by input assumptions. Some of the limitations of the assumption of thermal equilibrium between phases widely used in the calculation of critical flow and blowdown phenomena are presented. Another important phenomenon discussed is that of rewetting of overheated fuel cladding. Results of tests on Zircaloy and stainless steel tubes are compared with theoretical predictions. 17 references. (auth)

10159 (CONF-730304-, pp 740-757) SENSITIVITY STUDY WITH THE CODE BRUCH-D FOR THE ANALYSIS OF LOSS-OF-COOLANT ACCIDENTS. Karwat, H. (Technische Univ., Munich). 1973.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

In topical meeting on water-reactor safety.

A sensitivity study has been performed with the blowdown code BRUCH-D which showed important influences on the transient core mass flow rate and quality during the blowdown period by performance of the recirculation pumps after LOCA, size of assumed rupture, and coupling to core heat transfer mechanisms. Necessity for additional blowdown heat transfer experiments is pronounced. 13 references. (auth)

10160 (COO-2152-7) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATIONS. Quarterly Progress Report for Period Ending March 31, 1973. (Cincinnati Univ., Ohio. Dept. of Chemical and Nuclear Engineering). 1973. Contract AT(11-1)-2152. 13p. Dep. NTIS $3.00.

Progress in experiments on pressure drop and heat transfer phenomena of importance during a loss of coolant accident is reported. The experiments include transient pressure drop investigations, two-phase pressure drop and flow pattern studies, and transition boiling and reflooding heat transfer tests. (JWR)

10161 (GEAP-13921) ANALYSIS OF HYPOTHETICAL CORE DISRUPTIVE ACCIDENT (HCDA), APRIL–DECEMBER 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Dec 1972. Contract AT(04-3)-189. 116p. Dep. NTIS $5.45.

Hypothetical core disruptive accidents were analyzed using available GE and ANL codes to determine the characteristics and mechanical consequences of such accidents, and the adequacy of the codes for HCDA calculations of a representative LMFBR demonstration plant reactor. It is concluded from this study that the equivalent mechanical energy release for an HCDA in the demonstration plant lies between 0 and 100 MW-sec based on expansion of core material to 1 atmospheric pressure. All of the codes used were found to need revisions before they can be utilized for evaluation of containment design basis accidents in a demonstration plant. Analytical approaches used in these codes will require continued support from ongoing developmental programs, particularly in the areas relating to fuel–coolant interaction processes, sodium voiding dynamics and fuel motions under accident conditions. (auth)

10162 (IRS-F-8) CREST INFORMATION. Research Reports. (Technischer Ueberwachungs-Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Apr 1972. vpp. INIS.

A compilation of the various research projects for reactor safety, promoted by the Federal Ministry for Education and Science of the German Federal Republic is given. (INIS)

10163 (JAERI-M-5064) VIBRATION OF REACTOR STRUCTURE, PART II-8. FINALE-1: Response Spectrum and Fourier Spectrum Analysis Code. Ikushima, T. (Japan Atomic Energy Research Inst., Tokyo). Dec 1972. 29p. (In Japanese). NTIS (U. S. Sales Only).

Computer code FINALE-1 was prepared for analyzing the seismic response of structures, reactor vessels, cores, etc. Features of the code are as follows: acceleration response, displacement response, velocity response and Fourier spectrum can be calculated with this code; any form of input data can be taken as the input, for example, input data cards, tape or disk; either calculation of raw data or calculation of sine interpolation data can be chosen; integral time mesh can be chosen without restriction; calculation of start period, final period, and period division of one decade can be chosen without restriction; and calculation results can be represented with a graphic plotter. (auth)

10164 (MRR-100) INVESTIGATION OF THE EFFECTS OF VARIOUS PARAMETERS ON MELTDOWN OF A REACTOR CORE BY USE OF A MODIFIED VERSION OF THE CHEMLOC-II PROGRAM. Simon-Weidner, J. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Sep 1972. 45p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

For some time, safety analyses of modern reactors have considered the hypothetical case of heating-up of the core and the failure of all emergency cooling systems. Most of the physical data are not exactly known at these expected high temperatures and therefore the influence of some variables on meltdown processes in a core are studied following the CHEMLOC-II model. (auth)

10165 (NP-19763) REACTOR SAFETY RESEARCH PROGRAM. (Technischer Ueberwachungs-Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Nov 1972. 77p. Dep. NTIS (U. S. Sales Only) $6.00.

Information on the reactor safety research program for light water reactors in the German Federal Republic is presented. (JWR)

10166 (WCAP-8078) ICE CONDENSER CONTAINMENT PRESSURE TRANSIENT ANALYSIS METHODS. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Energy Systems Div.). Mar 1973. 104p.

The mathematical model developed to simulate the ice condenser pressure transients is described. The experimental verification of calculations made with the TMD code is discussed. (JWR)

10167 NUCLEAR POWER PLANTS NEAR TOWNS. Wilck, A. F. (1972). vp. (In German).

From congress on town planning and environment; Berlin, Germany (20 Sep 1972).

A survey is given of power plants and nuclear power plants located near towns, followed by a discussion of economic aspects of power generation in nuclear power plants sited in the vicinity of industrial installations and towns. Such topics as power generation and consumption, environmental exposure, reactor safety, radiation protection, and health hazards are discussed, mainly referring to the situation in the German Federal Republic FRG (e.g., in towns such as West Berlin and Ludwigshafen). Some examples are cited to show that objections raised against construction of nuclear power plants at certain sites are frequently not based on scientific background. The basic principles of reactor safety are presented by discussing such aspects as waste management, environmental protection, and cooling systems. It is suggested that the waste heat of a nuclear power plant be used to separate Pb and Hg from the sludge of the Lake of Constance and the Rhine. (GE)

10168 RELATING THE RISK OF FAILURE OF SAFETY MEASURES TO THE CONSEQUENCES WHICH MIGHT FOLLOW. Farmer, F. R. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp v of International Colloquium on Nuclear Energy and the Environment. Liege; Association Internationale de la Mutualite (1973).

From International colloquium on nuclear energy and the environment; Liege, Belgium (22 Jan 1973).

A description of the likely consequences of a large fission product release to atmosphere is presented and a risk rate of the order of 10^{-6} per reactor per year is proposed for such an event. Some of the implications of setting a target at a low level of risk are considered. Brief descriptions are given of the use of reliability data as an indication of the need to improve knowledge of plant performance and to develop a capability of analysis of complex systems. (auth)

10169 DIRECT MEASUREMENT OF VARIABLE AEROSOL CONCENTRATION IN FAST REACTOR CONTAINMENT VESSELS. Kitani, S.; Uno, S.; Takada, J. (Japan Atomic Energy Research Inst., Tokai). Kuki Seijo; 10: No. 2, 34-36(Jun 1972). (In Japanese).

It was required that change of aerosol concentration in containment vessels be measured automatically, in order to clarify behavior of fuel aerosol and sodium aerosol in the reactor containment vessels at the time of fast reactor failure. A method to optically evaluate the aerosol concentration was applied, because methods of determining the amount physically or chemically after collecting the aerosol on filter paper for a definite time requires much labor and time. The method employs a system which projects white light to the aerosol and detects scattered light in 135° direction to the incident light. It adopts digital indication for photoelectric current obtained in a photomultiplier, and also records it for a definite time with a printer. An experiment was performed on sodium oxide aerosol and uranium oxide aerosol. Although particle structure of both materials is very different, and particle size distribution varies as time elapses, good correlation between the concentration determined by sampling with an air filter and the relative scattered light intensity was obtained with this system. (JA)

10170 REACTOR CONSTRUCTION: SAFETY AND FUTURE USE OF NUCLEAR ENERGY. Nucleus (Bonn); 18: No. 37-38, 335-339(1972). (In German).

Explanatory remarks are given concerning the draft of the German Program for Reactor Safety (covering the years 1972–1976 with a budget of 180 million DM). The main points of this program are: use of nuclear energy in densely populated areas, biasing in competition by safety technology, assessment of reactor accidents, materials research and reliability of materials, monitoring, radiation protection. (GE)

10171 REACTOR SAFETY THROUGH QUALITY ASSURANCE AND IN-SERVICE INSPECTION. Bush, S. H. (Battelle Pacific Northwest Lab., Richland, WA). Nucl. News; 16: No. 8, 59-64; 66(Jun 1973).

The concept of quality control is discussed; some factors appearing repeatedly in all quality assurance documents are listed. Quality assurance and reliability are considered in two major divisions: (1) all operations prior to operation of the plant and (2) all operational phases of the plant. Periodic in-service inspection and the resulting reliability enhancement is discussed. Levels in weld examinations are tabulated. The reliability approach of O'Neil and Jordan, in which credit is given for improvements in design, construction, operation, and periodic in-service inspection, is modified, and the probability of gross vessel rupture between inspection periods is estimated to be $\sim 5 \times 10^{-6}$ per vessel year. (DLC)

Reactor Theory and Calculation

Refer also to abstracts 8093 and 10019.

10172 (AI-AEC-13076(Vol.3)) SELECTED COMPUTER CODES AND LIBRARIES. Volume III. COMPOZ: A Multigroup Transport Perturbation Code. Lekach, V. S. (Atomics International, Canoga Park, Calif.). 24 May 1973. Contract AT(04-3)-701. 59p. Dep. NTIS $5.00.

COMPOZ is a transport theory perturbation code designed to be used with the ANISN-based multigroup transport code, APC. The code calculates the reactivity worth of cross section sets included in the APC calculation, or sets included in the APC library. (auth)

10173 (BNWL-1736) MEASUREMENT OF TURBULENT VELOCITY, INTENSITY AND SCALE IN ROD BUNDLE FLOW CHANNELS. Rowe, D. S. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1973. Contract AT(45-1)-1830. 233p. Dep. NTIS $13.75.

An experimental study was performed to investigate the effect of flow channel geometry on fully developed turbulent flow in clean rod bundle flow channels. This information was sought to obtain a better understanding of crossflow mixing between rod bundle subchannels. The experimental measurements of turbulence velocity were performed with a two-component laser-Doppler velocimeter in approximately twice size models of nuclear reactor fuel rod bundle flow subchannels. The experimental flow models considered pitch-to-diameter ratios of 1.25 and 1.125. Axial components of velocity, turbulence intensity and Eulerian autocorrelation function were the primary measurements. A limited amount of lateral component turbulence intensity data was also obtained. The autocorrelation function provided an indication of the dominant frequency of turbulence and an estimate of the longitudinal macroscale by using Taylor's hypothesis. The experiments were performed in water with a Reynolds number range from 50,000 to 200,000. The experimental results show that rod gap spacing (pitch-to-diameter ratio) is the most significant geometric parameter affecting the flow structure. Decreasing the rod gap spacing increased the turbulence intensity, longitudinal macroscale, and the dominant frequency of turbulence. These turbulence parameters were found to be rather insensitive to Reynolds number. The turbulence parameters within a rod gap were found to be insensitive to the shape of adjacent subchannels and only slightly affected by the amount of lateral freedom allowed by the various size and shape of flow models considered. The results indicate that macroscopic flow processes exist adjacent to the rod gap. This includes secondary flows and increased scale and frequency of flow pulsations when the rod gap spacing is reduced. By considering the eddy diffusion coefficient to be related to the product of intensity and macroscale, the results show a compensating increase in eddy diffusion for a decrease in rod gap spacing. When interpreted in terms of crossflow mixing, the results are consistent with present crossflow mixing correlations. (auth)

10174 (CONF-730611-3) GENERALIZED SOURCE MULTIPLICATION METHOD. Greenspan, E. (Princeton Univ., N. J. Plasma Physics Lab.). 1972. Contract AT(11-1)-3073. 7p. Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

A generalized source multiplication method for absolute reactivity determinations is presented. The method is based on a comparison of the measured response of the critical and subcritical reactor to an external neutron source. (JWR)

10175 (CONF-730611-4) METHODS TO ACCOUNT FOR FINE STRUCTURE EFFECTS IN MULTIGROUP REACTIVITY CALCULATIONS. Greenspan, E. (Princeton Univ., N. J. Plasma Physics Lab.). 1972. Contract AT(11-1)-3073. 5p. Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

Two multigroup methods that can account for fine structure effects in reactivity calculations are compared. One method requires bilinear averaging and the other requires flux averaging of cross sections. It is concluded that the bilinear method gives the best results for first order perturbation theory. (JWR)

10176 (CONF-730611-5) FINE STRUCTURE EFFECTS AND THE CENTRAL WORTH DISCREPANCY. Greenspan, E. (Princeton Univ., N. J. Plasma Physics Lab.). 1972. Contract AT(11-1)-3073. 6p. Dep. NTIS $3.00.

From 19th annual meeting of the American Nuclear Society; Chicago, Illinois, USA (10 Jun 1973).

The effect of fine structure details in the resolved resonance region on material reactivity worths is analyzed. It is concluded that fine structure effects can have a significant contribution to reactivity worths and to other bilinear functionals. It is likely that these effects contribute to the central worth discrepancy as well as to discrepancies between measured and calculated values of other reactor parameters. (JWR)

10177 (EUR-4950) VELASCOE: VELOCITY FIELD IN ASYMMETRIC ROD CONFIGURATIONS. Eifler, W.; Nijsing, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1973. 134p. Dep. NTIS (U. S. Sales Only) $8.75. Eur B. Fr. 175.-.

A description is provided for VELASCOE, a computer program for the calculation of the isothermal and fully developed turbulent velocity distribution in fuel bundles with asymmetric rod configurations. A description is given of the physical and topographic model underlying the program. A complete listing of the program and the output for a thirty-seven rod bundle as a reference case are given as appendix. (auth)

10178 (EUR-5007) ACQUISITION AND PROCESSING OF NEUTRON FLUX DATA FOR REACTIVITY EVALUATION. Bernede, M.; Stanchi, L. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00. EUR B.Fr.40.-.

Equipment has been designed for the acquisition of neutron flux data coming from a nuclear facility into a Laben 70 computer. A suitable program then processes the data for evaluation of the reactivity. The instruments described include a peripheral unit for the digital acquisition and an interface card which is directly inserted into the computer. All the equipment was developed using monolithic integrated circuits. A particular synchronization logic for phasing the pulses corresponding to measurement time limits and to neutron flux is described. (auth)

10179 (EURFNR-1080) INTERCOMPARISON OF DIFFERENTIAL NEUTRON SPECTROMETRY TECHNIQUES IN THE MOL-ΣΣ FAST ASSEMBLY. Bluhm, H.; Fieg, G.; Werle, H.; Ames, H.; Braak, J. P.; Harry, R. J. S.; Montizaan, J.; De Leeuw Gierts, G.; De Leeuw, S. (Kernforschungszentrum, Karlsruhe (West Germany). Institute fuer Neutronenphysik und Reaktortechnik). Jul 1972. 40p. (KFK-1658; RCN-172; BLG-471). Dep. NTIS (U. S. Sales Only) $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The determination of neutron spectra by means of differential spectrometry techniques is a powerful tool to check and evaluate nuclear data. But to reach this objective it is of primary importance to define the confidence that may be attributed to the spectral results, errors and uncertainties related to many parameters. Though only an intercomparison on a large scale can give a valuable estimation of the uncertainties, the differential neutron spectrometry techniques of KFK, RCN and C.E.N./S.C.K., i.e., (n,p), ^{3}He(n,p)t and ^{6}Li(n,α)t were intercompared in the MOL ΣΣ fast assembly. With the care and precautions taken in the present work and under the experimental conditions described, an agreement of ±5% is generally found between 0.02 and 4 MeV, consequently the same confidence can stand for the neutron spectra measured in similar nuclear and experimental conditions. (GE)

10180 (GEAP-13771-5) CRITICAL EXPERIMENTS AND COOPERATIVE EVALUATIONS PROGRAM. Fifth Quarterly Report, October–December 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Dec 1972. Contract AT-(04-3)-189. 61p. Dep. NTIS $5.25.

Current activities and technical progress for the period October through December 1972, are reported for two tasks. Task A covers the planning and analysis of critical experiments in ZPPR-3. Task B progress is reported for nuclear data evaluation and testing and methods development in support of Task A. (auth)

10181 (ORNL-4628) ORIGEN: THE ORNL ISOTOPE GENERATION AND DEPLETION CODE. Bell, M. J. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 148p. Dep. NTIS $5.45.

ORIGEN is a versatile point depletion code which solves the equations of radioactive growth and decay for large numbers of isotopes with arbitrary coupling. The code uses the matrix exponential method to solve a large system of coupled, linear, first-order ordinary differential equations with constant coefficients. The general nature of the matrix exponential method permits the treatment of complex decay and transmutation schemes. An extensive library of nuclear data has been compiled, including half-lives and decay schemes, neutron absorption cross sections, fission yields, disintegration energies, and multigroup photon release data. ORIGEN has been used to compute the compositions and radioactivity of fission products, cladding materials, and fuel

materials in LWRs, LMFBRs, MSBRs, and HTGRs. The applications are illustrated with calculated inventories and radiation levels for spent fuel irradiated to a burnup of 33,000 MWd/metric ton in a PWR spectrum. (auth)

10182 FOUR-GROUP PHYSICAL SCHEME OF BURNUP IN UNIFORM HETEROGENEOUS URANIUM–WATER REACTORS. Apostolov, T. Izv. Fiz. Inst. Aneb, Bulg, Akad. Nauk.; 22: 73-80 (1972). (In Russian).

A four-group physical scheme of change of isotopic composition of burnup in heterogeneous uranium–water reactors was elaborated. The scheme is adapted for uranium burnup with an arbitrary degree of concentration. The differential equations are shown, describing the change of nuclear burnup concentration, namely of uranium-235, uranium-238, plutonium-239, and plutonium-241. The kinetic equations are carried out to a type convenient for numerical solution. The equations also are described for equilibrium concentration of xenon-135 and samarium-149. The non-universal four-group sections determination is made. The structural scheme for change determination of the effective coefficient of multiplication (k_{eff}) of the grid during the reactor work is given. (auth)

10183 DYNAMIC METHODS OF DETERMINING REACTOR REACTIVITY. Kalivoda, R.; Grof, V. (Skoda Works, Plzen, Czech.). Jad. Energ.; 19: No. 5, 146-151(May 1973). (In Czech).

Two methods of dynamic determination of reactivity based on reactor kinetics equations are described. The methods differ in the way of their derivations and in the choice of simplifications. Both methods are compared from the viewpoint of static and dynamic accuracy and possibility of process control computer application. The experiments are carried out on a reactor analogue computer model and on the real reactor SR–OA. The results of experiments are processed on a digital computer. (auth)

10184 CONVECTIVE HEAT TRANSFER IN ROD CLUSTERS WITH TURBULENT AXIAL COOLANT FLOW. Part 1. Mean Values over the Rod Perimeter. Markoczy, G. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Waerme Stoffuebertrag.; 5: No. 4, 204-212(1972). (In German).

Local and average heat transfer coefficients in rod bundles with axial coolant flow have been investigated analytically and experimentally. Based on new parameters correlations have been developed for the prediction of heat transfer in clusters with different rod arrangement. The proposed calculation method has been compared with the results of measurements and with data from the relevant literature. (GE)

10185 HETEROGENEITY EFFECTS ON ABSORPTION IN NONSTATIONARY DIFFUSION OF THERMAL NEUTRONS IN HETEROGENEOUS SYSTEMS. Ilieva, K.; Kazarnovskii, M. Izv. Fiz. Inst. Aneb, Bulg. Akad. Nauk.; 22: 65-71(1972). (In Russian).

The effect of heterogeneity on the absorption in nonstationary diffusion of thermal neutrons with the dependence of the dispersion section in the approximation of separable nucleus (Corngold–Dargan model) in limited grids with cylindrical canals was observed. The problem is solved by Stepanov's method in the case of diffusion approximation. Estimations are given for a water grid with step $2a = 2$ cm, with cylindrical canals with radius r_0, filled up with a strong absorptive substance with the absorption section changing by virtue of the law $1/v$. The non-elastic dispersion section in water in acceptable approximation is considered also changing by virtue of the law of $1/v$; the relation r_0/a is in the limits 0.5–0.8. It is shown that in reference to a homogenizing system in a heterogeneous medium, the effective absorption section decreases 8%, the deficient coefficient remains constant, while the diffusion refrigeration coefficient in practice shows no change. (auth)

10186 PHYSICS OF REACTORS. Iyengar, P. K.; Chandramoleshwar, K. (Bhabha Atomic Research Centre, Bombay). Sci. Cult. (Calcutta); 38: No. 10, 423-433(Oct 1972).

After a brief survey of the various sources of energy and of the forms of energy in atoms, the fission process is considered. The principles of the fission reactor are outlined; the different reactor classes, neutron cycle, and control are described. Some salient features of nuclear power production are discussed, and breeding is considered. (DLC)

10187 NEUTRON FLUCTUATIONS IN THE SLOWING-DOWN PROCESS. Fermi Age Approximation. Taniguchi, A. (Tokai Univ., Tokyo); Sako, O.; Matsumura, H. Tokai Diagaku Kiyo Kogakubu; 1972: No. 1, 27-32(Sep 1972). (In Japanese).

First, a property of the fluctuation in a Markoffian system is presented by using Lax's method. The Markoffian system of concern is defined as a system which involves essentially one-body collisions or similar transition processes only and does not involve any branching processes. Fluctuations in a system so defined indicate no correlation either spatially and energetically at steady state, their magnitude being equivalent to the steady-state value of the system in question. Consequently, information on the fluctuations in such a system is given by the steady-state value. Second, the Fermi-age equation is derived by using this approach; the fluctuations of neutron density are determined in a reactor core where the Fermi age theory holds. (auth)

Reactor Components and Accessories

Refer also to abstracts 8082, 8092, 8099, 8102, 8114, 8627, 8638, 8666, 8739, 8759, 8792, and 10150–10153.

10188 (JAERI-M-4758) HOLDING SPACER FOR NUCLEAR-FUEL RODS, ETC. Okazaki, M. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 27p. (In Japanese). INIS.

A new-type spacer, "Holding Spacer," which keeps nuclear-fuel rods or heat-exchanger pipes aligned is described. Two kinds of the holding spacer are discussed. General requirements for a spacer are reviewed, as are the mechanisms of hydraulic resistance and heat removal at the spacer. The holding spacer is expected to have many advantages over the conventional ones. (auth)

10189 MODERN STEAM TURBINES FOR POWER PLANTS. Koenig, H. H. Ind.-Anz.; 94: No. 108, 2590-2593(1972). (In German).

Since 1970, the electricity supply companies of the German Federal Republic have been ordering steam turbines and turbo generators of up to 800 MW gross capacity for thermal fossil fueled power stations, and turbosets of up to 1300 MW gross capacity for nuclear power plants (BWRs). These large single-shaft units are one of the most efficient turbines of the world. They are produced in modern industrial plants by competitive enterprises, and according to modern techniques. The design and special constructional features of these turbines are discussed. (GE)

10190 PULSATING LOADS IN PRESSURE COMPONENTS. Part 2. Tentative Standard for the Dimensioning of Pressure Vessels with Regard to Pulsating Internal Pressure. Schaar, K.; Gorsitzke, B. Tech. Ueberwach.; 14: No. 4, 118-124(1973). (In German).

The dimensioning of pressure parts subjected to pulsating internal pressure on the basis of static material data is justifiable if the design, manufacturing quality, and the operating conditions are taken into account in the calculations by introducing appropriate correlation functions. The calculation method presented permits the evaluation limits of the serviceable lifetime of the components due to pulsating loads and establishes appropriate safety criteria. (GE)

10191 VIBRATIONS IN APPARATUS AND PLANTS. Klapp, E. (Clausthal Technische Univ., Clausthal-Zellerfeld, Ger.). Haus der Technik, Essen, Vertragsveroeff.; No. 271, 37-45(1971). (In German).

For the evaluation of vibration phenomena one distinguishes generally between two different approaches: (1) Stability analysis for the clearing up of those system parameters responsible for the occurrence of vibrations. (2) Prediction of the response of the excited components. Both approaches are applied to the following typical vibration phenomena of plant technology: (a) Self-excited vibrations of crossflow tube bundles. (b) Forced vibrations of whole container components. (c) Coupling vibrations in structural components especially in large reactor pressure vessels. (GE)

10192 EXPORT OF NUCLEAR REACTOR PRESSURE VESSELS. Ishikawa, K. (Ishikawajima-Harima Heavy Industries Co., Ltd., Tokyo). Sangyo Kikai; No. 260, 71-74(May 1972). (In Japanese).

Two cases of the export of nuclear reactor vessels from Japan are introduced. One case is two reactor pressure vessels delivered to Browns Ferry nuclear plant in Tennessee Valley Authority, and another is the one for Ringhals nuclear plant in Swedish State Power Board. The former was designed, manufactured and inspected according to ASME Code Section III, and its materials were employed according to ASTM Standards. The latter was manufactured in conformity to Swedish Pressure Vessel Code. As the structural materials, low alloy steel of Mn–Mo–Ni and low alloy forged steel of Cr–Ni–Mo were employed. Welding was performed according to welding method and by licensed welders in conformity with the ASME Code and the Swedish Pressure Vessel Code, respectively. Most important problem in manufacturing

was prevention of stress corrosion of stainless steel. The successful manufacturing of these pressure vessels owed to not only manufacturing techniques, but also quality assurance program. As the inspection methods of the nuclear reactor vessels, ultrasonic test method was employed as well as other nondestructive test methods. Future problems to be resolved on the export of the nuclear reactor vessels are reduction of the cost by rationalization and of the disadvantage of long sea transport. (JA)

10193 SOME PROBLEMS OF OVERLAID CLADDING IN A NUCLEAR REACTOR PRESSURE VESSEL. II. Metallurgical Studies on Overlaid Cladding of a Reactor Pressure Vessel. Kodaira, T. (Japan Atomic Energy Research Inst., Tokai); Nakanishi, T.; Ishida, S. Yosetsu Gakkaishi; 41: No. 12, 1402-1409(Dec 1972). (In Japanese).

Steel pressure vessels for light-water cooled power reactors are constructed with stainless-steel weld overlay on their inner wall. The overlay weld is usually heat treated after welding to relieve the residual stresses in the welded joints of the pressure vessel steel. The postweld heat treatment, however, is considered to cause sensitization in the stainless steel overlaid cladding; thus it is important to examine the effect of this heat treatment on the overlay weld. The purpose of the present study is to obtain information on the relation between the change in mechanical properties and microstructure in the overlaid cladding and weld bond. Test materials and the conditions of heat treatment were the same as previously reported. Experiments in the study include microfractography by electron microscope and scanning electron microscope, optical micrography, microhardness measurement, and electron-probe microanalysis. The following conclusions were made: 1) In the stainless-steel overlaid cladding, the fracture after half-size Charpy test exhibits ductile fracture appearance with a dimple pattern in the as-welded specimens, but the mode changes to intergranular fracture appearance after heat treatment. In the latter case, the fracture occurs at the interface between precipitated carbide particles ($M_{23}C_6$) and the delta ferrite. It is thus considered that ductility loss in the overlaid cladding by postweld heat treatment is associated with the phase change including those in delta ferrite and carbide formation. 2) In the weld bond, the width of carbon migration from the base metal to the weld metal increases with time of the heat treatment and its temperature. The associated loss in ductility also increases similarly. (auth)

10194 VALVES FOR ATOMIC POWER PLANTS. Hirata, T. (Hirata Valve Industry Co, Ltd., Tokyo). Genshiryoku Kogyo; 18: No. 9, 39-42(Oct 1972). (In Japanese).

Continued in Vol. 18: No. 10, 38-42(Oct 1972).

In Japan, BWR and PWR predominate in nuclear power stations. Though the pressures involved in valves for these light-water cooled reactor plants are lower than those in modern thermal power plants, the requirements in quality control of their manufacture are far severer due to their extended service duration and the need for no accidents. First the regulations and the standards in quality control are described, including nondestructive inspection and manufacturing process. Then follows the explanation of structural materials for the respective components of valves. Finally, three particular types of valves are described in their need and mechanism: self seal seating valve, p-s butterfly valve, and ball valve. (JA)

10195 APPLYING THE EXPERIENCE GAINED IN NUCLEAR POWER PLANT DEVELOPMENT TO NON-NUCLEAR POWER AND PROCESS PLANTS. Hryniszak, W. (Clarke Chapman-John Thompson Ltd., Gateshead, Eng.). pp 315-347 of Development of Thermal Techniques in the Nuclear Field and Its Contribution to Other Applications. Rome; Comitato Nazionale per l'Energia Nucleare (1972).

From 16th nuclear congress; Rome, Italy (25 Mar 1971). See CONF-710317-.

The development in Great Britain of steam generators for nuclear reactors and the "spin off" from this government-financed research to industrial or commercial technology are discussed. (LCL)

10196 DIMENSIONING OF COMPONENTS ACCORDING TO STATISTICAL CRITERIA. Beckmann, G. (Waagner-Biro AG, Vienna). Tech. Ueberwach.; 14: No. 2, 37-42(1973). (In German).

Based upon statistical criteria, a calculating procedure is presented, which takes into account statistical deviations in geometry, load, and material properties. As to the deviations in load, only static overloads are considered, such as those due to manufacturing tolerances in single pipe strings. This calculating method is a helpful means for the safety engineer to balance the safety of components against dimensions and tolerances in order to find the optimum design. Although the method has been developed for calculating the thickness of tube walls in particular, some of the more general data used, as well as some of the formulas may well be applied, with more or less slight modifications, to the calculation of other components so that components whose dimensions have been calculated by this method can be integrated into the overall plant system (e.g. the steam generating system of a pebble bed reactor) as components with pre-set reliability. (GE)

Reactor Fuels

Refer also to abstracts 8544, 8546–8549, 8551, 8554, 8555, 8566, 8572, 8580, 8592, 8603, 8604, 8639, 8645, 8670, 8740, 8781, and 9944.

10197 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Adams, D. F.; Red, D. T. (to British Nuclear Fuels Ltd.). British Patent 1,306,939. 14 Feb 1973. Filed date 8 Jul 1969. 5p.

Reference is made to "wear pads" provided on the Zr alloy cladding of cluster type fuel elements at points of contact with the intermediate spacer grids, to reduce fretting of the fuel pins. The type of pads hitherto used are brazed to the cladding. Brazing results in local temperatures of the order of 1000°C, and since the cladding becomes fully annealed at about 500°C the desired cold-worked properties are lost locally. This could result in high cladding failure rates. The "wear pads" described comprise a material deposited by plasma spraying. Although the plasma temperature is 15,000 to 20,000°C the heat transferred to the substrate by the process is very low. The heat sink capacity of a typical fuel cladding will keep the temperature thereof down to a maximum of about 300°C, and with simple cooling techniques the temperature can be held down to about 100°C. Even 300°C is well below the temperature at which annealing occurs. An advantage also is that harder materials may be used than with brazing, and also materials that cannot be secured by brazing. Preparation for plasma spraying may be by grit blasting. (UK)

10198 GENERALIZED RELATIONSHIPS FOR HEAT TRANSFER IN THE FUEL ASSEMBLIES OF NUCLEAR REACTORS WITH LIQUID METAL COOLING. Bobkov, V. P.; Ibragimov, M. Kh. High Temp. (USSR) (Engl. Transl.); 10: No. 4, 713-720(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 4, 795-803(1972).

By using a wide range of experimental data together with approximate simulation theory and various methods of calculating hydrodynamic flow parameters, as well as a statistical analysis of turbulent heat transfer and many different computing procedures, generalized relationships are derived for the heat-transfer coefficients and the temperature-field nonuniformities associated with the flow of molten metal in the "unit cells" of channels with cross sections of complicated shapes. (auth)

10199 NUCLEAR REACTORS. Barnett, P. G. (to United Kingdom Atomic Energy Authority). British Patent 1,308,895. 7 Mar 1973. Filed date 13 Jan 1971. 6p.

Reference is made to coolant flow deflectors in fuel element channels housing fuel element clusters arranged end-to-end and spaced apart. In the arrangement described the fuel elements in each cluster are disposed in concentric rings with an annular flow deflector within the space between end regions of at least one pair of rings of fuel elements, the deflector being arranged to baffle coolant flow issuing from between adjacent elements of a ring of elements. The deflector redistributes coolant flow issuing from the upstream fuel element cluster so that flow disturbances at entry to the downstream cluster are small and the resultant variations in heat transfer coefficient around the fuel elements at entry are correspondingly small. The deflector is preferably disposed nearer to the upstream fuel elements than the downstream elements. The deflectors may be attached to grid structures carried by central tubes of the clusters. Constructional embodiments for a gas cooled reactor are described. (UK)

10200 FUEL ELEMENT FOR NUCLEAR REACTORS. Boettcher, A.; Barthels, H. (to Kernforschungsanlage Juelich GmbH). German Patent 1,945,056. 22 Apr 1971. Filed date 5 Sep 1969. (In German).

The fuel is in the form of a porous, mechanically solid body in a metal sheath forming the external surface of the covered element with a material of carbides and/or of carbon and/or metallic material formed of round particles with a diameter of about 150 to 1500 microns or with the two end surfaces of the sheath, respectively. A plate in the form of a sieve is provided characterized by the fact that the porous fuel material has a prismatic or cylindrical form with one or more channels parallel to the axis of the metallic sheath and after introduction into the reactor parallel to the direction of the flow of the coolant around the core of the reactor. (TSS)

10201 SPACER FOR NUCLEAR REACTOR FUEL ELEMENTS. Bezold, H. (to Siemens AG). German Patent 1,764,030. 8 Apr 1971. Filed date 23 Mar 1968. (In German).

A diagram shows how the fuel rods are held in place by sheet metal bands and connected in a rectangular arrangement to keep them rigid and to allow rods to be put in and removed. The framework is attached to the sides of the apertures at least two of which are flattened by mechanical deformation during the constitution of the fuel element and are good conductors of heat. (TSS)

10202 FUEL ELEMENT FOR A NUCLEAR REACTOR. Fedders, H. (to Kernforschungsanlage Juelich GmbH). German Patent 1,956,786. 6 May 1971. Filed date 12 Nov 1969. (In German).

A fuel element is described which has a wall made up of particles of fuel material arranged at some distance around a central axis in the form of a curved surface and forming a channel parallel to the recovered axis with a material containing some carbide such as silicon carbide and/or a metallic material. The thickness of the wall is very slight because of the porosity of the capillaries formed. Hardly more than 1% of the refrigerant provided for cooling penetrates the wall by filtration after introduction into the reactor. An alignment is provided for a convection force flux because of the destruction of the limiting layer formed outside the surface of the exit of the filtration current. (TSS)

10203 SPACER SUPPORT FOR FUEL ELEMENTS WITH A LARGE NUMBER OF FUEL RODS. Christ, R.; Christiansen, U. (to Nukem Nuklear Chemie and Metallurgie GmbH). German Patent 1,764,185. 3 Jun 1971. Filed date 19 Apr 1968. (In German).

A spacer support following the requirement of patent OSD N29,073 is characterized by the fact that the square sections containing tubes are supplied with springs to press the fuel rods against a relatively rigid grillwork with corrugated walls. (TSS)

10204 TEST ON COMPONENT TEST LOOP. Nakada, S. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Japan). Doryokuro Giho; No. 5, 29-37(Aug 1972). (In Japanese).

A component test loop was constructed in Oarai engineering center in December 1969, in order to perform out-core mockup test of fuel assemblies, pressure pipe assemblies, and seal plugging by simulating cooling conditions in a prototype advanced thermal reactor. At the start, this component test loop was used for the endurance test and fluid flow characteristic test of the fuel assemblies, but recently, above all, it contributes to the solution of technical problems and confirmation of the mechanism and performance of the fuel assemblies and others. This component test loop consists of a main loop which generates and recirculates mixed two-phase flow of high-temperature, high-pressure water and vapor and some test sections. As for the endurance test of the fuel assemblies, fuel assemblies of primary, secondary, and tertiary manufacture for trial for the prototype reactor have been investigated so far. These test results have been reflected in the improvement of structural design and assessment of in-core recirculation pumping power. Seal plugging test, pressure pipe assemblies test, failed fuel detection test are also commenced. (JA)

10205 PROCEDURE AT AND PLANT FOR TREATMENT OF OBJECTS, ESPECIALLY FUEL RODS FOR NUCLEAR REACTORS, WITH LIQUIDS. Mueller, M. F. T.; Bukholt, B. (to Atomenergikommissionen). DA 15,141. 2 Jan 1973. Filed date 11 Jun 1969. 7p. (In Danish).

A description is given of the procedure for treatment of objects, especially fuel rods for nuclear reactors, with active and passive liquids for e.g. pre-flushing, pickling, and after-flushing, in a closed, vertical process vessel. The active liquid from a storage tank is fed into the process vessel from above for a quick flushing and at the same time the process vessel is filled from below with the active liquid so that the objects become completely submerged in the active liquid. The active liquid is then made to circulate until at the end of the treatment period the liquid is suddenly drained, and the objects are then suddenly flushed with and finally submerged in the passive liquid. The treatment plant is described. (auth)

Reactor Control Systems

Refer also to abstracts 8290 and 10000.

10206 (DEU-72-11) AEG CONTROL ROD SYSTEM FOR BOILING WATER REACTORS. (Allgemeine Elektricitaets Gesellschaft, AEG-Telefunken, Frankfurt am Main (West Germany)). 1972. 16p. (In German). INIS.

Following a short explanation of the use and design of a control rod and control rod drive, a description of the construction of the control rod drive is given. The drives of the Lingen, Grosswelzheim (HDR) and Wuergassen reactors are mentioned as examples. A new scram system is described. The AEG-Telefunken production program of control rod system is illustrated by photos. (INIS)

10207 (NAA-SR-9615) SNAP REACTOR CONTROL-DRUM DRIVE. Kellogg, L. G. (Atomics International, Canoga Park, Calif.). 24 Aug 1964. Contract AT(11-1)-Gen-8. 92p. Dep. NTIS $6.75.

Declassified 3 May 1973.

The SNAP 2, 10A, and 8 nuclear systems are designed to provide electrical power on space vehicles. Although each system has different power capabilities, the control-drum-drive components are basically the same. Development of the various control-drum-drive components and subcomponents from GFY 1962 to mid-GFY 1964 is discussed. The design criteria are outlined for each SNAP system. Comparisons are made between the systems to evaluate their design and operation in the prescribed environment. The components and subcomponents reviewed are the actuator, controller, bearings, gears, and flexible couplings. Data are presented to describe development of the SNAP 10A reference design, and both the reference and backup designs for the SNAP 2 and SNAP 8 systems. In addition to the integrated control-drum-drive reference designs, four possible backup design schemes are also presented for SNAP 2 and SNAP 8. Each scheme is discussed in terms of structural and mechanical design, thermal heating, and nuclear shielding considerations. The concept of a direct-drive actuator mounted above the drum is promising, and further study is planned. A control-drum-drive scheme that provides failsafe scram capabilities for ground testing of the reactor system has been designed and proof tested. The details of this design as it applies to SNAP 8 systems are presented. (auth)

10208 (TID-25952-P1) NUCLEAR POWER REACTOR INSTRUMENTATION SYSTEMS HANDBOOK. Volume 1. Harrer, J. M.; Beckerley, J. G. (eds.) (Argonne National Lab., ILL; Atomic Energy Commission, Washington, D. C.). 1973. 313p. (ISBN-0-87079-005-6). Dep. NTIS $7.60.

A guide to the instrumentation systems used to monitor and control nuclear power plants is presented. Chapters are included on fundamental considerations, out-of-core radiation sensors, in-core neutron sensors, process instrumentation, neutron-flux signal conditioning, transfer-function measurement systems, control-rod drives and indicating systems, process computer applications and data handling, power supplies, installation of instrumentation systems, and quality assurance and reliability. (JWR)

10209 DYNAMIC BEHAVIOR OF THIN CYLINDRICAL SHELLS COLLIDED WITH DAMPERS. Suzuki, S. I. (Nagoya Univ., Japan). 24: No. 2, 188-194(1973).

Dynamic behavior of thin cylindrical shells of finite length is investigated for the case where they collide with a spring with constant velocity. The relationships between dimensions of a cylinder, spring constant and maximum values of dynamic displacements and stresses are obtained. The fundamental equations of motion are derived, taking into account radial displacement, and are solved by the Laplace transformation method. From the results of theoretical analysis, it became evident that impulsive stresses are damped considerably by a spring. (auth)

10210 ADAPTIVE NUCLEAR REACTOR CONTROL BASED ON OPTIMAL LOW-ORDER LINEAR MODELS. Bereznai, G. T. (Ontario Hydro Nuclear Training Centre, Rolphton). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 72-82 (Apr 1973).

The problem of optimally controlling the power level changes of a nuclear reactor for a wide variety of cost functions is considered. Admissible performance indexes are arbitrary functions of the power level and its derivative as well as of the reactivity input and its derivative. The proposed method is based on the use of optimal second-order models, the parameters of which are computed on-line to produce piece-wise approximations to the response of the plant. While the controller parameters, which give optimal performance for the model, result in only a suboptimal system response, the deviations between the two converge rapidly to zero. The proposed technique is illustrated by computing the responses of a power reactor for integral quadratic cost functions, as well as for least pth and minimax criteria. The results indicate that near-optimal performance may be achieved under conditions encountered in practice. (auth)

10211 STABILITY ANALYSIS OF A NUCLEAR REACTOR CONTROL SYSTEM WITH MULTIPLE TRANSPORT LAGS. Hu, C. L. (Chiao-Tung Univ., Taiwan); Han, K. W. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 83-93(Apr 1973).

Control systems with multiple transport lags are analyzed using the parameter-plane and parameter-space methods. A chemical

system operated for the automatic control of a nuclear reactor is considered, and a comparison of the result with current literature is given. (auth)

10212 STABILIZATION OF A COUPLED-CORE REACTOR CONTROL SYSTEM USING ARTIFICIAL DITHER. Tsouri, N.; Rootenberg, J.; Lidofsky, L. J. (Columbia Univ., New York). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-20: No. 2, 94-99(Apr 1973).

The use of a perfect relay in the automatic control of a coupled-core reactor results in an undesirable limit-cycle, regardless of the reactivity rate demand. In order to enable the use of a perfect relay, artificial dither is inserted into the control system loop. The principle and the nature of the stabilization signal that eliminates possible limit-cycle in the system are presented. An example is presented to illustrate the procedure, and digital computer simulation results are given. (auth)

10213 MULTIVARIABLE-CONTROL-SYSTEM DESIGN CONCEPTS IN FAILURE ANALYSIS OF A CLASS OF NUCLEAR-REACTOR SPATIAL-CONTROL SYSTEMS. Owens, D. H. (Atomic (Atomic Energy Establishment, Winfrith, Eng.). Proc. Inst. Elec. Eng. (London); 120: No. 1, 119-125(Jan 1973).

Given a symmetrical sector-control configuration for the control of the azimuthal modes of a cylindrical power reactor and a feedback-control design which produces the required stability and transient responses of each of the dominant spatial modes of that system, the problem of system reliability, in the sense of stability with respect to sensor or control-actuator failure in any one sector, must be investigated. A simple relationship is derived between the transfer-function elements of the multivariable closed-loop system and the reliability of that system with respect to a class of failures which can be represented by a zero transmission path in one of the loops, together with some known system input. For example, a jammed control rod no longer has any effect on the dynamics of the system, but will introduce static effects. The use of the relationship as a constraint in the final closed-loop design is discussed by reference to an example. (auth)

10214 OPERATING AND INFORMATION TECHNOLOGY IN A THERMAL POWER PLANT. Freymeyer, P.; Gondosch, M.; Kraft, M. Energiewirt. Tagesfragen; 23: No. 3, 88-94(1973). (In German).

Based on the historic development and the state of the technology as well as on possible developments, an attempt has been made to give a concept of a modern control station for an automatic power plant with fossil or nuclear fuel. (GE)

10215 CRITERION FOR THE SELECTION OF A REACTOR PROTECTION SYSTEM. Incerti, S. M. Calore; 43: No. 10, 476-485(Oct 1972). (In Italian).

The criterion chosen for a reactor protection system is described. Fundamental logics are compared, for electronic arrangements. Values are assumed and the theoretical upper limits of the logics for the electronic systems are compared. (auth)

10216 PROCESS CONTROL SYSTEM FOR POWER PLANTS. Pohr, M.; Zinke, H. BBC-Nachr.; 53: No. 11-12, 337-346(1971). (In German).

Modern control engineering has reached a state of development that offers the possibility of replacing the more conventional control systems for power plants by process control computers which offer great advantages over the conventional systems, both with regard to technology and economics, particularly if the control system calls for the recording of a large number of data, the solution of complex problems, and flexible operation in order to enable modifications and extensions to be made. (GE)

10217 ASEISMIC DESIGN OF NUCLEAR INSTRUMENTATION. Uchiyama, Y. (Hitachi Ltd., Ibaraki, Japan); Sato, H.; Miyazaki, Y. Hitachi Hyoron; 54: No. 10, 877-882(Oct 1972). (In Japanese).

In Hitachi, Ltd., a series of vibration experiments have been made on electrical equipment, especially control panels, for nuclear power plants, to confirm the validity of seismic design and to check on the reliability of computer codes. Instrument acceleration is caused with building resonance, so this must be avoided as far as possible. In the aseismic design of the control panels, two types are considered, i.e., plate- and frame-structure. The plate structure type is equipped with unit drawers containing relays, transformers, etc. on the front. By supporting it at the top, acceleration response can be largely improved. In the frame-structured control panels, many relays are installed on the front panel. By attaching reinforcing plates to it, aseismic protection can be increased considerably. Results of the calculation of natural frequency and vibration mode obtained by computer codes agreed well with those by experiment, especially in case of the frame-type panels. (JA)

Nuclear Power Plant Economics

10218 MONETARY CORRECTION MODEL OF ECONOMIC ANALYSES APPLIED TO NUCLEAR POWER COSTS. McGuire, S. A.; Martin, J. G. (Instituto Militar de Engenharia, Rio de Janeiro). Nucl. Technol.; 18: No. 3, 257-266(Jun 1973).

In the past, the electric utility companies have been able to ignore inflation rates of ~1.6%/yr in their planning because technological improvements managed to maintain a gap of ~1% between the rates of increase of the consumer price index and the cost of electricity. This stability in the price of electricity is not likely to continue; for the years 1968 through 1971 the inflation rate averaged 5.0%/yr, the cost of petroleum rose 3.2%/yr, and the cost of coal increased by 16.0%/yr, causing large increases in utility costs. Drawing from conventional economics and the experience of other countries with a long history of inflation, the effect of expected fuel, operation, and maintenance cost escalation on the price of electricity and on the relative competitiveness of nuclear and fossil-fuel plants is shown. A self-consistent mode of cost computation using a "monetary correction" to account for inflation shows that, in relation to fossil-fuel electric power, nuclear power is ~15% more economical than most conventional comparisons indicate. The implications are important for the establishment of a national energy policy and have repercussions in other capital-intensive schemes. (auth)

10219 OFF SHORE NUCLEAR POWER STATIONS IN EUROPE. Siebker, M. H. (Commission of the European Communities, Brussels). At. Strom; 19: No. 1-2, 26-27(1973). (In German).

One method of solving the difficulties connected with finding suitable sites for nuclear power stations is to build platforms off the sea coast. There are different methods to which there are no objections and which must first be examined commercially, independent of the conditions in Europe, before planning can be commenced or industrial measures be taken. The complexity of the problems is outlined. (GE)

10220 PHOTOGRAMMETRY IN POWER STATION ENGINEERING. Fuchs, H. (Rheinische Braunkohlenwerke AG; Cologne). Brennst.-Waerme-Kraft; 25: No. 3, 79-84(1973). (In German).

Photogrammetric measuring methods are discussed. The possible application of these modern methods, including special processes, for the choice and investigation of sites, planning and supervision of the erection of nuclear power stations are briefly explained. (GE)

10221 PROBLEMS OF HEAT SUPPLY FROM NUCLEAR POWER PLANTS. Reetz, B.; Gundermann, E. (Technical Univ., Dresden). Kernenergie; 15: No. 7, 225-229(Jul 1972). (In German).

Primary energy carriers are of great importance to nuclear energy. Heat-power coupling is favored by the selection of the sites of nuclear power plants close to the centers of high demand for energy. Demand characteristics of the heat processes determine technological solutions of integrating heat supply systems into nucelar power plants and the restrictions of coupling products. The thermodynamic efficiency of plant processes is improved, and expenses for the cooling system are decreased by diminishing the amount of heat to be removed in the condenser. The advantage of process energy may be utilized by optimally designing the heat transfer system for unconventional radii of supply. (auth)

Reactor Licensing and Regulation

10222 (DOCKET-50003-173) INDIAN POINT STATION, UNIT 1. Steam Driven Motor-Generator Set Malfunction. (Consolidated Edison Co. of New York, Inc., New York). 17 May 1973. 2p. Dep. NTIS $3.00.

10223 (DOCKET-50003-174) INDIAN POINT STATION, UNIT 1. Over Exposure of Individual. (Consolidated Edison Co. of New York, Inc., New York). 9 May 1973. 4p. Dep. NTIS $3.00.

10224 (DOCKET-50003-175) INDIAN POINT STATION, UNIT 1. Indemnity Agreement B-19, Endorsement 57. (Consolidated Edison Co. of New York, Inc., New York). 11 May 1973. 2p. Dep. NTIS $3.00.

10225 (DOCKET-50003-176) INDIAN POINT STATION, UNIT 1. Technical Specifications, Request for Change. (Consolidated Edison Co. of New York, Inc., New York). 18 May 1973. 5p. Dep. NTIS $3.00.

10226 (DOCKET-50003-177) INDIAN POINT STATION, UNIT 1. Emergency Core Cooling System, Additional Informa-

tion. (Consolidated Edison Co. of New York, Inc., New York). 1 Jun 1973. 8p. Dep. NTIS $3.00.

10227 (DOCKET-50010-158) DRESDEN NUCLEAR POWER STATION, UNIT 1. Plans for a Modified Off-gas System. (Commonwealth Edison Co., Chicago, ILL). 14 May 1973. 3p. Dep. NTIS $3.00.

10228 (DOCKET-50010-159) DRESDEN NUCLEAR POWER STATION, UNIT 1. Unloading Heat Exchanger System. (Commonwealth Edison Co., Chicago, Ill.). 8 May 1973. 2p. Dep. NTIS $3.00.

10229 (DOCKET-50010-160) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Response to Request for Overdue Items. (Commonwealth Edison Co., Chicago, Ill.). 18 May 1973. 7p. (DOCKET-50237-328; DOCKET-50249-224). Dep. NTIS $3.00.

10230 (DOCKET-50010-161) DRESDEN NUCLEAR POWER STATION, UNIT 1. Review for Control Circuit Deficiencies. (Commonwealth Edison Co., Chicago, Ill.). 15 May 1973. 2p. Dep. NTIS $3.00.

10231 (DOCKET-50010-162) DRESDEN NUCLEAR POWER STATION, UNIT 1. Proposed Change to Appendix A of DPR-2. (Commonwealth Edison Co., Chicago, Ill.). 17 May 1973. 170p. Dep. NTIS $10.50.

10232 (DOCKET-50010-164) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Quad-Cities Station, Units 1 and 2. Reporting Requirements. (Commonwealth Edison Co., Chicago, Ill.). 1 Dec 1972. 2p. (DOCKET-50237-329; DOCKET-50249-225; DOCKET-50254-200; DOCKET-50265-190). Dep. NTIS $3.00.

10233 (DOCKET-50010-165) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Quad Cities Station, Units 1 and 2. Valve Wall Thickness. (Commonwealth Edison Co., Chicago, Ill.). 24 May 1973. 4p. (Docket-50237-330; Docket-50249-226; Docket-50254-201; Docket-50265-191). Dep. NTIS $3.00.

10234 (DOCKET-50010-166) DRESDEN NUCLEAR POWER STATION, UNIT 1. Special Report 27, High Pressure Coolant Injection System, Conceptual Design for Dresden Unit 1. (Commonwealth Edison Co., Chicago, Ill.). 16 May 1973. 23p. Dep. NTIS $3.25.

10235 (DOCKET-50010-167) DRESDEN NUCLEAR POWER STATION, UNIT 1. Emergency Condenser Shell Side Water Temperature Exceeded Maximum Limit. (Commonwealth Edison Co., Chicago, Ill.). 21 Mar 1973. 2p. Dep. NTIS $3.00.

10236 (DOCKET-50010-168) DRESDEN NUCLEAR POWER STATION, UNIT 1. Valve Failed to Open on Signal. (Commonwealth Edison Co., Chicago, Ill.). 5 May 1973. 2p. Dep. NTIS $3.00.

10237 (DOCKET-50010-169) DRESDEN NUCLEAR POWER STATION, UNIT 1. Valve Failed to Close on Signal. (Commonwealth Edison Co., Chicago, Ill.). 9 May 1973. 2p. Dep. NTIS $3.00.

10238 (DOCKET-50010-170) DRESDEN NUCLEAR POWER STATION, UNITS 1 AND 2. Special Report No. 21, Measurements of Radioactivity in Process Systems of the Dresden Nuclear Power Station and in the Environment, January–February 1971. (Commonwealth Edison Co., Chicago, Ill.). Apr 1973. 132p. (DOCKET-50237-335). Dep. NTIS $8.75.

10239 (DOCKET-50016-194) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Report for January 1973. (Power Reactor Development Co., Detroit, Mich.). 30 May 1973. 14p. (PRDC-EF-113). Dep. NTIS $3.00.

10240 (DOCKET-50029-246) YANKEE NUCLEAR POWER STATION. Valve Wall Thickness. (Yankee Atomic Electric Co., Westboro, Mass.). 19 Mar 1973. 2p. Dep. NTIS $3.00.

10241 (DOCKET-50029-252) YANKEE NUCLEAR POWER STATION. Inspection Report No. 50-29/73-02. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 17 Apr 1973. 12p. Dep. NTIS $3.00.

10242 (DOCKET-50029-253) YANKEE NUCLEAR POWER STATION. Inspection Report No. 50-29/73-02. (Yankee Atomic Electric Co., Rowe, Mass.). 31 May 1973. 1p. Dep. NTIS $3.00.

10243 (DOCKET-50029-254) YANKEE NUCLEAR POWER STATION. AO-73-2, Electrical Disturbance on Transmission Line. (Yankee Atomic Electric Co., Rowe, Mass.). 14 May 1973. 1p. Dep. NTIS $3.00.

10244 (DOCKET-50029-255) YANKEE NUCLEAR POWER STATION. AO-73-5, Failure of No. 1 Emergency Diesel Generator. (Yankee Atomic Electric Co., Rowe, Mass.). 7 Jun 1973. 1p. Dep. NTIS $3.00.

10245 (DOCKET-50029-256) YANKEE NUCLEAR POWER STATION. Control Rod Surveillance Testing Data, June 6, 1973. (Yankee Atomic Electric Co., Westboro, Mass.). 8 Jun 1973. 2p. Dep. NTIS $3.00.

10246 (DOCKET-50133-119) HUMBOLDT BAY POWER PLANT, UNIT 3. Technical Specifications, Proposed Change No. 46. (Pacific Gas and Electric Co., San Francisco, Calif.). 17 May 1973. 19p. Dep. NTIS $3.00.

10247 (DOCKET-50133-121) HUMBOLDT BAY POWER PLANT, UNIT 3. Steps Taken to Correct Items Brought to Attention Following Inspection of December 4–7 and 18, 1972. (Pacific Gas and Electric Co., San Francisco, Calif.). 29 May 1973. 33p. Dep. NTIS $3.75.

10248 (DOCKET-50133-122) HUMBOLDT BAY POWER PLANT, UNIT 3. Material Status Report Returned for Proper Signature. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 29 Mar 1973. 1p. Dep. NTIS $3.00.

10249 (DOCKET-50155-156) BIG ROCK POINT PLANT. AO-10-73, Excessive Pump Shaft Packing Leakage. (Consumers Power Co., Jackson, Mich.). 18 May 1973. 2p. Dep. NTIS $3.00.

10250 (DOCKET-50155-157) BIG ROCK POINT PLANT. AO-3 thru 8-73, Six Abnormal Occurrences. (Consumers Power Co., Jackson, Mich.). 8 May 1973. 4p. Dep. NTIS $3.00.

10251 (DOCKET-50171-123) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. An Evaluation of Pipe Breaks Outside Containment. (Philadelphia Electric Co., PA). May 1973. 130p. Dep. NTIS $8.50.

10252 (DOCKET-50206–201) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Cycle 3 Fuel Densification Report. (Southern California Edison Co., Rosemead, Calif.). 15 May 1973. 2p. Dep. NTIS $3.00.

10253 (DOCKET-50206-202) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis, Amendment 29. (Southern California Edison Co., Rosemead, Calif.). 9 May 1973. 47p. Dep. NTIS $4.50.

Additional information concerning the quality assurance program at the San Onofre Nuclear Generating Station, Unit 1, is presented. (JWR)

10254 (DOCKET-50213–192) HADDAM NECK PLANT, UNIT 1. Draft Environmental Statement, Comments of Federal Railroad Administration. (Department of Transportation, Washington, D. C.). 8 May 1973. 2p. Dep. NTIS $3.00.

10255 (DOCKET-50213-193) HADDAM NECK PLANT, UNIT 1. Environmental report, Addenda 7. (Connecticut Yankee Atomic Power Co., Hartford). 14 May 1973. 4p. Dep. NTIS $3.00.

Corrected information concerning the thermal effluent plume from the Haddam Neck Plant, Unit 1, is presented. (JWR)

10256 (DOCKET-50213-195) HADDAM NECK PLANT, UNIT 1. Environmental report, Addenda 6. (Connecticut Yankee Atomic Power Co., Hartford). 18 May 1973. 26p. Dep. NTIS $3.50.

Information on the Connecticut River ecological studies at the Haddam Neck Plant, Unit 1, is presented. (JWR)

10257 (DOCKET-50213-196) HADDAM NECK PLANT, UNIT 1. Quality Assurance Program. (Connecticut Yankee Atomic Power Co., Hartford). 7 May 1973. 18p. Dep. NTIS $3.00.

10258 (DOCKET-50213-197) HADDAM NECK PLANT, UNIT 1. Draft Environmental Statement, Comments of Advisory Council on Historic Preservation. (Advisory Council on Historic Preservation, Washington, D. C. (USA)). 23 May 1973. 1p. Dep. NTIS $3.00.

10259 (DOCKET-50213-198) HADDAM NECK PLANT, UNIT 1. Draft Environmental Statement, Comments of the Department of Commerce. (Department of Commerce, Washington, D. C.). 22 May 1973. 3p. Dep. NTIS $3.00.

10260 (DOCKET-50213-199) HADDAM NECK PLANT, UNIT 1. Operation Report No. 73-4 for the Month of April. (Connecticut Yankee Atomic Power Co., Haddam). 29 May 1973. 14p. (NYO-3144-83). Dep. NTIS $3.00.

10261 (DOCKET-50213-200) HADDAM NECK PLANT, UNIT 1. Letdown Isolation Trip Valve Wouldn't Close. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 4 Jun 1972. 1p. Dep. NTIS $3.00.

10262 (DOCKET-50213-201) HADDAM NECK PLANT, UNIT 1. Plant Modifications to Protect from Flooding. (Connecticut Yankee Atomic Power Co., Hartford). 30 May 1973. 2p. Dep. NTIS $3.00.

10263 (DOCKET-50213-203) HADDAM NECK PLANT, UNIT 1. Draft Environmental Statement, Comments of Soil Conservation Service and Forest Service. (Department of Agriculture, Washington, D. C.). 11 May 1973. 4p. Dep. NTIS $3.00.

10264 (DOCKET-50213-204) HADDAM NECK PLANT, UNIT 1. Technical Specifications, Proposed Changes. (Connecticut Yankee Atomic Power Co., Hartford). 29 Mar 1973. 1p. Dep. NTIS $3.00.

10265 (DOCKET-50219-258) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change Request 14. (Jersey Central Power and Light Co., Morristown, N. J.). 23 Apr 1973. 4p. Dep. NTIS $3.00.

Information concerning a technical specifications change for the refueling interlock load setting at the Oyster Creek Nuclear Power Plant, Unit 1, is presented. (JWR)

10266 (DOCKET-50219-260) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Facility Change Request No. 4, Supplement 4. (Jersey Central Power and Light Co., Morristown, N. J.). 22 May 1973. 3p. Dep. NTIS $3.00.

Additional information regarding the minimum shutdown margin reported in Facility Change Request No. 4 for the Oyster Creek Nuclear Power Plant, Unit 1, is presented. (JWR)

10267 (DOCKET-50219-261) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Request for Authorization to Operate at Low Power with Reactor Head Removed. (Jersey Central Power and Light Co., Morristown, NJ). 15 May 1963. 1p. Dep. NTIS $3.00.

10268 (DOCKET-50219-263) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Failure of Torus to Reactor Building Vacuum Relief Valve V-26-18. (Jersey Central Power and Light Co., Morristown, NJ). 15 May 1973. 2p. Dep. NTIS $3.00.

10269 (DOCKET-50219-264) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change Request No. 15. (Jersey Central Power and Light Co., Morristown, N. J.). 10 May 1973. 7p. Dep. NTIS $3.00.

Information on a technical specifications change concerning the safety limits for operation of the Oyster Creek Nuclear Power Plant, Unit 1, to insure that a minimum critical heat flux ratio greater than unity will be maintained is presented. (JWR)

10270 (DOCKET-50219-265) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Steps Taken to Correct Violations Brought to Attention Following Inspection on March 13, 1973. (Jersey Central Power and Light Co., Morristown, N. J.). 16 Apr 1973. 18p. Dep. NTIS $3.00.

10271 (DOCKET-50219-266) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Failure of Liquid Poison Pump, NPO1A. (Jersey Central Power and Light Co., Morristown, N. J.). 30 May 1973. 2p. Dep. NTIS $3.00.

10272 (DOCKET-50219-267) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Modification to Radioactive Waste Facility. (Jersey Central Power and Light Co., Morristown, N. J.). 1 Jun 1973. 52p. Dep. NTIS $4.75.

10273 (DOCKET-50220-137) NINE MILE POINT NUCLEAR STATION, UNIT 1. State water discharge permit. (Niagara Mohawk Power Corp., Syracuse, N. Y.) 10 May 1973. 22p. Dep. NTIS $3.25.

10274 (DOCKET-50220-138) NINE MILE POINT NUCLEAR STATION, UNIT 1. Cracks discovered in Reactor Steam Dryer assembly. (Niagara Mohawk Power Corp., Lycoming, N. Y.) 7 May 1973. 1p. Dep. NTIS $3.00.

10275 (DOCKET-50220-139) NINE MILE POINT NUCLEAR STATION, UNIT 1. Proposed cask drop protection system, additional information. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 31 May 1973. 20p. Dep. NTIS $3.00.

10276 (DOCKET-50220-142) NINE MILE POINT NUCLEAR STATION, UNIT 1. Leakage of main steam isolation valves. (Niagara Mohawk Power Corp., Lycoming, N. Y.). 6 Jun 1973. 2p. Dep. NTIS $3.00.

10277 (DOCKET-50237-327) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Special report No. 25, rod drop accident analysis. Quad-Cities Station, Units 1 and 2. Special report No. 9, rod drop accident analysis. (Commonwealth Edison Co., Chicago, IL). May 1973. 25p. (DOCKET-50249-219; DOCKET-50254-194; DOCKET-50265-183). Dep. NTIS $3.25.

10278 (DOCKET-50237-331) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Safety analysis report, revision to proposed modification 73-1. (Commonwealth Edison Co., Chicago, Ill.). 16 May 1973. 2p. (DOCKET-50249-227). Dep. NTIS $3.00.

10279 (DOCKET-50237-332) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Safety analysis report, Proposed Modification 73-1, page 3. (Commonwealth Edison Co., Chicago, Ill.). 16 May 1973. 2p. (DOCKET-50249-229). Dep. NTIS $3.00.

Requested information is presented concerning the fuel quality assurance program. (DCC)

10280 (DOCKET-50237-334) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Emergency diesel generators tripped on high temperature. (Commonwealth Edison Co., Chicago, Ill.). 1 Jun 1973. 4p. (DOCKET-50249-230). Dep. NTIS $3.00.

10281 (DOCKET-50237-336) DRESDEN NUCLEAR POWER STATION, UNIT 2. Three control rod drives gave indication of an apparent uncoupled condition. (Commonwealth Edison Co., Chicago, Ill.). 13 Mar 1973. 2p. Dep. NTIS $3.00.

10282 (DOCKET-50244-155) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Monthly report of activity measurements, April 1–30, 1973. (Rochester Gas and Electric Corp., NY). 17 May 1973. 4p. Dep. NTIS $3.00.

10283 (DOCKET-50244-157) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Technical specifications, request for changes. (Rochester Gas and Electric Corp., NY). 23 May 1973. 16p. Dep. NTIS $3.00.

10284 (DOCKET-50244-158) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Valve wall thickness. (Rochester Gas and Electric Corp., NY). 22 May 1973. 2p. Dep. NTIS $3.00.

10285 (DOCKET-50244-159) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Undervoltage device did not operate on May 29, 1973. (Rochester Gas and Electric Corp., NY). 30 May 1973. 2p. Dep. NTIS $3.00.

10286 (DOCKET-50244-160) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Rod control system malfunction. (Rochester Gas and Electric Corp., NY). 31 May 1973. 1p. Dep. NTIS $3.00.

10287 (DOCKET-50244-161) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Fuel rod end plug examination. (Rochester Gas and Electric Corp., NY). 1 Jun 1973. 2p. Dep. NTIS $3.00.

10288 (DOCKET-50244-162) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Draft environmental statement, comments of Office of Assistant Secretary of Commerce. (Department of Commerce, Washington, DC). 1 Jun 1973. 3p. Dep. NTIS $3.00.

10289 (DOCKET-50244-163) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Draft environmental statement, comments of Rochester Gas and Electric Corporation. (Rochester Gas and Electric Corp., NY). 4 Jun 1973. 27p. Dep. NTIS $3.50.

10290 (DOCKET-50244-164) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Draft environmental statement, comments of Advisory Council on Historic Preservation. (Advisory Council on Historic Preservation, Washington, DC (USA)). 5 Jun 1973. 1p. Dep. NTIS $3.00.

10291 (DOCKET-50244-166) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Draft environmental statement, comments of the Department of Agriculture. (Department of Agriculture, Washington, DC). 12 Jun 1973. 1p. Dep. NTIS $3.00.

10292 (DOCKET-50244-167) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Failure of undervoltage relay. (Rochester Gas and Electric Corp., NY). 8 Jun 1973. 2p. Dep. NTIS $3.00.

10293 (DOCKET-50244-168) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Draft environmental statement, comments of State of New York, Department of Environmental Conservation. (New York State Dept. of Environmental Conservation, Albany, NY). 12 Jun 1973. 12p. Dep. NTIS $3.00.

10294 (DOCKET-50244-169) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Technical specifications, Proposed Change 10. (Rochester Gas and Electric Corp., NY). 12 Jun 1973. 10p. Dep. NTIS $3.00.

10295 (DOCKET-50244-171) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change 8. (Directorate of Licensing (AEC), Washington, D. C.). 15 May 1973. 11p. Dep. NTIS $3.00.

10296 (DOCKET-50245-220) MILLSTONE NUCLEAR POWER PLANT, UNITS 1 AND 2. Draft Environmental Statement, Additional Comments. (Millstone Point Co., Hartford, CT). 18 May 1973. 18p. (DOCKET-50336-57). Dep. NTIS $3.00.

10297 (DOCKET-50245-221) MILLSTONE NUCLEAR POWER PLANT, UNIT 1. Control blades. (Millstone Point Co., Hartford, CT). 30 Jan 1973. 1p. Dep. NTIS $3.00.

10298 (DOCKET-50245-222) MILLSTONE NUCLEAR POWER PLANT, UNIT 1. AO-73-6, Gear Housing Cracked (Millstone Point Co., Hartford, CT). 18 May 1973. 2p. Dep. NTIS $3.00.

10299 (DOCKET-50245-224) MILLSTONE NUCLEAR POWER STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of United States Environmental Protection Agency. (Environmental Protection Agency, Washington, D. C. (USA)). 25 May 1973. 19p. (DOCKET-50336-59). Dep. NTIS $3.00.

10300 (DOCKET-50245-225) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Feedwater Spargers. (Millstone Point Co., Hartford, CT). 21 May 1973. 1p. Dep. NTIS $3.00.

10301 (DOCKET-50245-226) MILLSTONE NUCLEAR POWER PLANT, UNIT 1. Localized flux tilt. (Millstone Point Co., Hartford, CT). 18 May 1973. 2p. Dep. NTIS $3.00.

10302 (DOCKET-50245-227) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Feedwater sparger failure. (Millstone Point Co., Hartford, CT). 12 Jun 1973. 92p. Dep. NTIS $6.75.

10303 (DOCKET-50245-228) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Proposed change in facility. (Millstone Point Co., Hartford, CT). 29 May 1973. 8p. Dep. NTIS $3.00.
The isolation condenser break detection logic was changed to utilize normally opening flow switches, connected in parallel, which would close on an isolation condenser high-flow condition. Closing the flow switches will energize the logic relay and close the isolation condenser isolation valves. (FS)

10304 (DOCKET-50245-230) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Change 12. (Directorate of Licensing (AEC), Washington, D. C.). 16 May 1973. 30p. Dep. NTIS $3.50.

10305 (DOCKET-50247-109) INDIAN POINT NUCLEAR GENERATING UNIT 2. Technical specifications, request for authorization of a change. (Consolidated Edison Co. of New York, Inc., NY). 4 May 1973. 3p. Dep. NTIS $3.00.

10306 (DOCKET-50247-110) INDIAN POINT NUCLEAR GENERATING UNIT 2. Leaking valve. (Consolidated Edison Co. of New York, Inc., NY). 14 May 1973. 2p. Dep. NTIS $3.00.

10307 (DOCKET-50247-111) INDIAN POINT NUCLEAR GENERATING UNIT 2. Inspection report No. 50-247/73-07. (Directorate of Regulatory Operations (AEC), Newark, NJ Region I). 23 Apr 1973. 12p. Dep. NTIS $3.00.

10308 (DOCKET-50247-112) INDIAN POINT NUCLEAR GENERATING UNIT 2. Leak observed on weld. (Consolidated Edison Co. of New York, Inc., NY). 16 May 1973. 2p. Dep. NTIS $3.00.

10309 (DOCKET-50247-113) INDIAN POINT NUCLEAR GENERATING UNIT 2. Main steam line isolation valve failed to close. (Consolidated Edison Co. of New York, Inc., NY). May 1973. 1p. Dep. NTIS $3.00.

10310 (DOCKET-50247-114) INDIAN POINT NUCLEAR GENERATING UNIT 2. Leaking valve. (Consolidated Edison Co. of New York, Inc., NY). 21 May 1973. 2p. Dep. NTIS $3.00.

10311 (DOCKET-50247-115) INDIAN POINT NUCLEAR GENERATING UNIT 2. Fuel densification. (Consolidated Edison Co. of New York, Inc., NY). 29 Mar 1973. 2p. Dep. NTIS $3.00.

10312 (DOCKET-50247-116) INDIAN POINT NUCLEAR GENERATING UNIT 2. AO-3-2-4, leak at weld; AO-3-2-5, freeze in refrigerated dryer of instrument air system. (Consolidated Edison Co. of New York, Inc., NY). 25 May 1973. 4p. Dep. NTIS $3.00.

10313 (DOCKET-50247-117) INDIAN POINT NUCLEAR GENERATING UNIT 2. AO-3-2-6, high head safety injection pump not operative. (Consolidated Edison Co. of New York, Inc., NY). 29 May 1973. 2p. Dep. NTIS $3.00.

10314 (DOCKET-50247-118) INDIAN POINT NUCLEAR GENERATING UNIT 2. Loss of control air on May 18, 1973; motor operated valve didn't open on May 19, 1973; spurious safety injection signal was initiated on June 1, 1973; flow trip settings below those specified on June 7, 1973. (Consolidated Edison Co. of New York, Inc., NY). 8 Jun 1973. 5p. Dep. NTIS $3.00.

10315 (DOCKET-50247-119) INDIAN POINT NUCLEAR GENERATING UNIT 2. AO-3-2-7, malfunction of motor operated valve. (Consolidated Edison Co. of New York, Inc., NY). 11 Jun 1973. 2p. Dep. NTIS $3.00.

10316 (DOCKET-50249-220) DRESDEN NUCLEAR POWER STATION, UNIT 3. Inspection report No. 050-249/73-02. (Directorate of Regulatory Operations (AEC), Glen Ellyn, IL). Region III). 25 Apr 1973. 7p. Dep. NTIS $3.00.

10317 (DOCKET-50249-228) DRESDEN NUCLEAR POWER STATION, UNIT 3. Switch out of calibration. (Commonwealth Edison Co., Morris, IL (USA)). 21 May 1973. 2p. Dep. NTIS $3.00.

10318 (DOCKET-50250-130) TURKEY POINT PLANT, UNIT 3. Power outages of April 3 and 4. (Directorate of Regulatory Operations (AEC), Washington, DC). 20 Apr 1973. 5p. Dep. NTIS $3.00.

10319 (DOCKET-50250-131) TURKEY POINT PLANT, UNITS 3 AND 4. Technical Specifications, Change 6. (Directorate of Licensing (AEC), Washington, D. C.). 17 May 1973. 2p. (DOCKET-50251-114). Dep. NTIS $3.00.

10320 (DOCKET-50251-113) TURKEY POINT PLANT, UNIT 4. AO-4-73-5, Generic Failure of 14 Inch Gate Valves. (Florida Power and Light Co.). 22 May 1973. 2p. Dep. NTIS $3.00.

10321 (DOCKET-50251-115) TURKEY POINT PLANT, UNIT 4. AO-4-73-3, 4A RHR Pump Leakage. (Florida Power and Light Co.). 18 May 1973. 2p. Dep. NTIS $3.00.

10322 (DOCKET-50254-202) QUAD CITIES STATION, UNITS 1 AND 2. Excess Chlorine Residual Concentrations in Discharge Bay. (Commonwealth Edison Co., Cordova, ILL). 11 May 1973. 1p. (DOCKET-50265-192). Dep. NTIS $3.00.

10323 (DOCKET-50254-203) QUAD-CITIES STATION, UNITS 1 AND 2. Design Error in the Wiring of a Safety Related System. (Commonwealth Edison Co., Cordova, Ill.). 11 May 1973. 3p. (DOCKET-50265-193). Dep. NTIS $3.00.

10324 (DOCKET-50254-209) QUAD-CITIES STATION, UNITS 1 AND 2. Isotope Release Rate Exceeded. (Commonwealth Edison Co., Cordova, Ill). 11 Jun 1973. 2p. (Docket-50265-205). Dep. NTIS $3.00.

10325 (DOCKET-50255-159) PALISADES PLANT. Special Report No. 7, One Hundred Percent Power Escalation Testing.

(Consumers Power Co., Jackson, Mich.). 25 May 1973. 14p. Dep. NTIS $3.00.

10326 (DOCKET-50255-160) PALISADES PLANT. Initial Operation of Modified Liquid Radwaste System Will Begin About May 21, 1973. (Consumers Power Co., Jackson, Mich.). 8 May 1973. 1p. Dep. NTIS $3.00.

10327 (DOCKET-50255-163) PALISADES PLANT. Inspection Report No. 050-255/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 25 May 1973. 9p. Dep. NTIS $3.00.

10328 (DOCKET-50255-164) PALISADES PLANT. Technical Specifications, Change 7. (Directorate of Licensing (AEC), Washington, D.C.). 13 Jun 1973. 8p. Dep. NTIS $3.00.

10329 (DOCKET-50259-93) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Design Deficiency in Control Rod Drive and Standby Gas Treatment Systems. (Tennessee Valley Authority, Chattanooga). 8 May 1973. 4p. (DOCKET-50260-85; DOCKET-50296-81). Dep. NTIS $3.00.

10330 (DOCKET-50260-89) BROWNS FERRY NUCLEAR POWER STATION, UNIT 2. Steps Taken to Correct Item of Apparent Violation Brought to Attention in Letter Dated April 17, 1973. (Tennessee Valley Authority, Chattanooga). 4 May 1973. 26p. Dep. NTIS $3.50.

10331 (DOCKET-50261-168) H. B. ROBINSON UNIT 2. Draft Environmental Statement, Comments of South Carolina State Commission of Forestry. (South Carolina State Commission of Forestry, Columbia (USA)). 27 Apr 1973. 1p. Dep. NTIS $3.00.

10332 (DOCKET-50261-170) H. B. ROBINSON UNIT 2. Environmental Monitoring Report, October 1, 1972–December 31, 1972. (Eberline Instrument Corp., West Columbia, S. C. (USA)). 24 Apr 1973. 42p. Dep. NTIS $4.25.

10333 (DOCKET-50261-174) H. B. ROBINSON UNIT 2. Draft Environmental Statement, Comments of Charleston District, Corps of Engineers. (Corps of Engineers, Charleston, S. C. (USA). Charleston District). 7 May 1973. 1p. Dep. NTIS $3.00.

10334 (DOCKET-50261-177) H. B. ROBINSON, UNIT 2. Quality Assurance Program. (Carolina Power and Light Co., Raleigh, NC). 21 May 1973. 14p. Dep. NTIS $3.00.

10335 (DOCKET-50261-178) H. B. ROBINSON UNIT 2. Inquiry Report No. 50-261/73-3Q, Uncontrolled Loss of Contaminated Refueling Water to Offsite Drainage. (Carolina Power and Light Co., Raleigh, N. C.). 1 Jun 1973. 6p. Dep. NTIS $3.00.

10336 (DOCKET-50261-185) H. B. ROBINSON UNIT 2. Draft Environmental Statement, Comments of Department of Transportation, U. S. Coast Guard. (Department of Transportation, Washington, D. C.). 5 Jun 1973. 1p. Dep. NTIS $3.00.

10337 (DOCKET-50261-189) H. B. ROBINSON UNIT 2. Technical Specifications, Change 18. (Directorate of Licensing (AEC), Washington, D. C.) 15 May 1973. 10p. Dep. NTIS $3.00.

10338 (DOCKET-50261-190) H. B. ROBINSON UNIT 2. Technical Specifications, Change 19. (Directorate of Licensing (AEC), Washington, D. C.). 13 Jun 1973. 11p. Dep. NTIS $3.00.

10339 (DOCKET-50263-207) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Current Breakers. (Northern States Power Co., Minneapolis, Minn.). 15 Mar 1973. 1p. Dep. NTIS $3.00.

10340 (DOCKET-50263-209) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Reactor Building to Torus Vacuum Breaker Differential Control Switch Set Point Change. (Northern States Power Co., Minneapolis, MN). 16 May 1973. 1p. Dept. NTIS $3.00.

10341 (DOCKET-50263-210) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Malfunction of No. 1 Starting System of No. 11 Emergency Diesel Generator. (Northern States Power Co., Minneapolis, MN). 14 May 1973. 2p. Dep. NTIS $3.00.

10342 (DOCKET-50263-211) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Inspection Report No. 050-263/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 10 May 1973. 20p. Dep. NTIS $3.00.

10343 (DOCKET-50263-212) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Improper Design of the Main Steam Chase Blowout Panels. (Northern States Power Co., Minneapolis, Minn.). 23 May 1973. 1p. Dep. NTIS $3.00.

10344 (DOCKET-50263-213) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Inoperability of a Primary Containment Valve T-Ring Seal. (Northern States Power Co., Minneapolis, Minn.). 25 May 1973. 2p. Dep. NTIS $3.00.

10345 (DOCKET-50263-214) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. High Pressure Coolant Injection System Inoperability. (Northern States Power Co., Minneapolis, Minn.). 25 May 1973. 2p. Dep. NTIS $3.00.

10346 (DOCKET-50263-219) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specifications, Change 7. (Directorate of Licensing (AEC), Washington, D. C.). May 1973. 2p. Dep. NTIS $3.00.

10347 (DOCKET-50265-194) QUAD-CITIES STATION, UNIT 2. Excessive Leakage Measurement. (Commonwealth Edison Co., Cordova, IL). 16 May 1973. 3p. Dep. NTIS $3.00.

10348 (DOCKET-50265-195) QUAD-CITIES STATION, UNIT 2. Unavailability of Shared Diesel Generator. (Commonwealth Edison Co., Cordova, IL). 15 May 1973. 2p. Dep. NTIS $3.00.

10349 (DOCKET-50265-200) QUAD-CITIES STATION, UNIT 2. Steps Taken to Correct Items of Apparent Noncompliance Brought to Attention in Letter Dated April 2, 1973. (Commonwealth Edison Co., Chicago, Ill.). 30 Apr 1973. 20p. Dep. NTIS $3.00.

10350 (DOCKET-50265-201) QUAD-CITIES STATION, UNIT 2. Diesel Generator Could Not be Restarted. (Commonwealth Edison Co., Cordova, Ill.). 20 May 1973. 2p. Dep. NTIS $3.00.

10351 (DOCKET-50265-202) QUAD-CITIES STATION, UNIT 2. Missing Valve Components. (Commonwealth Edison Co., Cordova, Ill.). 23 May 1973. 2p. Dep. NTIS $3.00.

10352 (DOCKET-50265-203) QUAD-CITIES STATION, UNIT 2. Failure of the Shared Diesel-Generator Turbocharger Unit. (Commonwealth Edison Co., Cordova, Ill.). 25 May 1973. 2p. Dep. NTIS $3.00.

10353 (DOCKET-50266-109) POINT BEACH NUCLEAR PLANT, UNIT 1. Failure During Test of Non-Safeguards Bus Undervoltage Relay. (Wisconsin Electric Power Co., Milwaukee). 14 May 1973. 2p. Dep. NTIS $3.00.

10354 (DOCKET-50266-112) POINT BEACH NUCLEAR PLANT, UNIT 1. Steam Generator Cladding Repairs. (Wisconsin Electric Power Co., Milwaukee). 24 Apr 1973. 29p. Dep. NTIS $3.50.

10355 (DOCKET-50267-60) FORT ST. VRAIN NUCLEAR GENERATING STATION. Fact Sheet Relative to Application for NPDES Permit to Discharge Liquid Effluent. (Environmental Protection Agency, Denver, Colo. (USA)). 24 Apr 1973. 16p. Dep. NTIS $3.00.

10356 (DOCKET-50267-63) FORT ST. VRAIN NUCLEAR GENERATING STATION. Inspection Report No. 50-267/73-03. (Directorate of Regulatory Operations (AEC), Denver, Colo. Region IV). 15 May 1973. 16p. Dep. NTIS $3.00.

10357 (DOCKET-50267-65) FORT ST. VRAIN NUCLEAR GENERATING STATION. Deficiency in Standby Diesel Generators. (Public Service Co. of Colorado, Denver). 19 Apr 1973. 3p. Dep. NTIS $3.00.

10358 (DOCKET-50267-67) FORT ST. VRAIN NUCLEAR GENERATING STATION. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 12 Jun 1973. 7p. Dep. NTIS $3.00.

10359 (DOCKET-50269-110) OCONEE NUCLEAR STATION, UNIT 1. Valve Wall Thickness Measurements, Additional Information. (Duke Power Co., Charlotte, N. C.). 30 Mar 1973. 4p. (DOCKET-50270-90; DOCKET-50287-81). Dep. NTIS $3.00.

10360 (DOCKET-50269-112) OCONEE NUCLEAR STATION, UNIT 1. Inspection Report No. 50-269/73-3. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 1 Jun 1973. 31p. Dep. NTIS $3.75.

10361 (DOCKET-50269-113) OCONEE NUCLEAR STATION, UNIT 1. Inspection Report No. 50-269/73-5. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 1 Jun 1973. 12p. Dep. NTIS $3.00.

10362 (DOCKET-50270-92) OCONEE NUCLEAR STATION, UNIT 2. Inspection Report No. 50-270/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 10 Apr 1973. 33p. Dep. NTIS $3.75.

10363 (DOCKET-50270-93) OCONEE NUCLEAR STATION, UNIT 2. Inspection Report No. 50-270/73-5. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 1 Jun 1973. 17p. Dep. NTIS $3.00.

10364 (DOCKET-50275-42) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Draft Environmental Statement, Response to Comments by Department of the Interior and State of California. (Pacific Gas and Electric Co., San Francisco, Calif.). 8 May 1973. 20p. (DOCKET-50323-38). Dep. NTIS $3.00.

10365 (DOCKET-50275-44) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). May 1973. 508p. (DOCKET-50323-40). Dep. NTIS $27.50.

The environmental effects of construction and operation of the Diablo Canyon Power Reactor Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (DCC)

10366 (DOCKET-50278-85) PEACH BOTTOM ATOMIC POWER STATION, UNIT 3. Deficiency in the Core Spray Sparger. (Philadelphia Electric Co., PA). 11 May 1973. 3p. Dep. NTIS $3.00.

10367 (DOCKET-50280-134) SURRY POWER STATION, UNITS 1 AND 2. Notice of Violation. (Atomic Energy Commission, Washington, D. C.). 15 May 1973. 18p. (DOCKET-50281-106). Dep. NTIS $3.00.

10368 (DOCKET-50280-135) SURRY POWER STATION, UNITS 1 AND 2. Water Temperature Monitoring Program. (Virginia Electric and Power Co., Richmond). 3 May 1973. 3p. (DOCKET-50281-107). Dep. NTIS $3.00.

10369 (DOCKET-50280-136) SURRY POWER STATION, UNITS 1 AND 2. Fuel Densification Pressure Analysis. (Westinghouse Electric Corp., Pittsburgh, PA). Apr 1973. 69p. (DOCKET-50281-108; WCAP-8117). Dep. NTIS $5.50.

10370 (DOCKET-50280-137) SURRY POWER STATION, UNITS 1 AND 2. Preoperational Surveillance Program. (Virginia Electric and Power Co., Richmond). 18 May 1973. 437p. (DOCKET-50281-109). Dep. NTIS $24.00.

10371 (DOCKET-50280-138) SURRY POWER STATION, UNITS 1, 2 AND 3. Cooperative Program With the Commonwealth of Virginia for Effluent and Environmental Monitoring. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 30 May 1973. 3p. (DOCKET-50281-110; DOCKET-50338-73). Dep. NTIS $3.00.

10372 (DOCKET-50282-117) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Restraint of Safety Injection System and Residual Heat Removal Piping During Hot Functional Testing. (Northern States Power Co., Minneapolis, Minn.). 24 Apr 1973. 3p. (DOCKET-50306-110). Dep. NTIS $3.00.

10373 (DOCKET-50282-119) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Inspection Report No. 050-282/73-09. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 7 May 1973. 3p. Dep. NTIS $3.00.

Information on the implementation of security plans at the Prairie Island Nuclear Generating Plant, Unit 1, is presented. (JWR)

10374 (DOCKET-50282-120) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Inspection Reports No. 050-282/73-06 and No. 050-306/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 1 May 1973. 24p. (DOCKET-50306-112). Dep. NTIS $3.25.

10375 (DOCKET-50282-121) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Inspection Report No. 050 282/73-08. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 3 May 1973. 12p. Dep. NTIS $3.00.

10376 (DOCKET-50285-87) FORT CALHOUN STATION, UNIT 1. Mutual Atomic Energy Liability Underwriters Policy No. MF-63 Has Been Bound. (Mutual Atomic Energy Liability Underwriters, New York (USA)). 26 Mar 1973. 1p. Dep. NTIS $3.00.

10377 (DOCKET-50289-100) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Ultrasonic Indications in Reactor Coolant Piping. (Metropolitan Edison Co., Reading, PA). 28 Mar 1973. 43p. Dep. NTIS $4.25.

10378 (DOCKET-50289-101) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Operating Quality Assurance Program. (Metropolitan Edison Co., Reading, PA). 18 May 1973. 3p. Dep. NTIS $3.00.

10379 (DOCKET-50293-140) PILGRIM NUCLEAR POWER STATION. Response To Questions 5 Through 10 of Letter January 23, 1973. (Boston Edison Co., Mass.). 15 May 1973. 9p. Dep. NTIS $3.00.

10380 (DOCKET-50293-141) PILGRIM NUCLEAR POWER STATION. UO-73-7, Reactor Building Closed Cooling Water Pump 202C Trip. (Boston Edison Co., Mass.). 22 May 1973. 1p. Dep. NTIS $3.00.

10381 (DOCKET-50293-142) PILGRIM NUCLEAR POWER STATION. AO-73-16, Differential Pressure Indicating Switch Failed to Close. (Boston Edison Co., Mass.). 21 May 1973. 2p. Dep. NTIS $3.00.

10382 (DOCKET-50293-143) PILGRIM NUCLEAR POWER STATION. Atlantic Menhaden Mortalities, April 8-April 24, 1973. (Boston Edison Co., Mass.). 11 May 1973. 32p. Dep. NTIS $3.75.

10383 (DOCKET-50293-144) PILGRIM NUCLEAR POWER STATION. NELIA Policy NF-188, Endorsements No. 13 And No. 14. MAELU Policy NF-58, Endorsements No. 24 And No. 25. (Boston Edison Co., Mass.). 30 Apr 1973. 5p. Dep. NTIS $3.00.

10384 (DOCKET-50295-110) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 050-295/73-16. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 20 Apr 1973. 22p. Dep. NTIS $3.25.

10385 (DOCKET-50295-111) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 050-295/73-17. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 23 Apr 1973. 18p. Dep. NTIS $3.00.

10386 (DOCKET-50295-114) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Loss of High Voltage Power to Source Range Monitors While Reactor was Shutdown. (Commonwealth Edison Co., Zion, Ill. (USA)). 2 May 1973. 4p. Dep. NTIS $3.00.

10387 (DOCKET-50295-117) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Reportable Deficiency, Main Steam Check Valves. (Commonwealth Edison Co., Chicago, Ill.). 27 Apr 1973. 4p. Dep. NTIS $3.00.

10388 (DOCKET-50295-118) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Steps Taken To Correct Items Of Noncompliance Brought To Attention Following Inspection Of March 7 And 8, 1973. (Commonwealth Edison Co., Chicago, Ill.). 4 May 1973. 20p. Dep. NTIS $3.00.

10389 (DOCKET-50295-119) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Modifications to Heat Exchangers. (Commonwealth Edison Co., Chicago, Ill.). 24 Apr 1973. 3p. (DOCKET-50304-96). Dep. NTIS $3.00.

10390 (DOCKET-50295-122) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Nuclear Materials Safeguards Inspection Of Special Nuclear Material. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 31 Oct 1972. 9p. (DOCKET-701302-1). Dep. NTIS $3.00.

10391 (DOCKET-50295-123) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 050-295/73-20. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 15 May 1973. 6p. Dep. NTIS $3.00.

10392 (DOCKET-50295-124) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Potential Degradation of One of The Containment Barriers. (Commonwealth Edison Co., Chicago, Ill.). 24 May 1973. 3p. Dep. NTIS $3.00.

10393 (DOCKET-50298-78) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 23. (Nebraska Public Power District, Columbus). 10 May 1973. 91p. Dep. NTIS $6.75.

The environmental technical specifications for the Cooper Nuclear Station are presented. (JWR)

10394 (DOCKET-50298-79) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 24. (Nebraska Public Power District, Columbus). 11 May 1973. 33p. Dep. NTIS $3.75.

Revised and additional data are presented concerning the fuel, flux asymmetries, gaseous and liquid radioactive wastes, and plans and equipment for monitoring inside and outside of the containment during a design basis accident. (FS)

10395 (DOCKET-50302-73) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Final Safety Analysis Report, Amendment 26. (Florida Power Corp., St. Petersburg). 18 May 1973. 229p. Dep. NTIS $13.50.

Revised and requested information is presented concerning the reactor site, quality control program during component fabrication, cooling system, containment structure, electrical system, radiation protection, and radioactive waste disposal. (DCC)

10396 (DOCKET-50302-74) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. NELIA Policy No. NF-195, Declaration Page and Endorsements 1 Through 12. (Florida Power Corp., St. Petersburg). 9 May 1973. 17p. Dep. NTIS $3.00.

10397 (DOCKET-50302-75) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). May 1973. 404p. Dep. NTIS $22.25.

The environmental effects of construction and operation of the Crystal River Power Reactor Unit 3 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (DCC)

10398 (DOCKET-50302-76) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Inspection Report No. 50-302/73-3. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 30 May 1973. 12p. Dep. NTIS $3.00.

10399 (DOCKET-50304-99) ZION STATION NUCLEAR POWER PLANT, UNIT 2. Inspection Report No. 050-304/73-05. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 14 May 1973. 19p. Dep. NTIS $3.00.

10400 (DOCKET-50305-83) KEWAUNEE NUCLEAR POWER PLANT. Fuel Densification. (Westinghouse Electric Corp., Pittsburgh, PA). Mar 1973. 75p. (WCAP-8093). Dep. NTIS $5.75.

10401 (DOCKET-50305-84) KEWAUNEE NUCLEAR POWER PLANT. Inspection Report No. 050-305/73-05. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 9 May 1973. 12p. Dep. NTIS $3.00.

10402 (DOCKET-50309-113) MAINE YANKEE ATOMIC POWER STATION. Operational Difficulties With CEA No. 19. (Maine Yankee Atomic Power Co., Westboro, Mass.). 10 Apr 1973. 4p. Dep. NTIS $3.00.

10403 (DOCKET-50312-75) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Minor Imperfections In Pipe Welds. (Directorate of Licensing (AEC), Washington, D. C.). 26 Apr 1973. 2p. Dep. NTIS $3.00.

10404 (DOCKET-50312-76) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Inspection Report No. 050-0312/73-02. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 15 May 1973. 15p. Dep. NTIS $3.00.

10405 (DOCKET-50313-78) ARKANSAS NUCLEAR ONE, UNIT 1. Steps Taken To Correct Apparent Violation Brought To Attention Following Inspection of February 20–23, 1973. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 29 May 1973. 38p. Dep. NTIS $4.00.

10406 (DOCKET-50313-79) ARKANSAS NUCLEAR ONE, UNIT 1. Electrical Review. (Arkansas Power and Light Co., Little Rock). 11 May 1973. 5p. Dep. NTIS $3.00.

10407 (DOCKET-50313-80) ARKANSAS NUCLEAR ONE, UNIT 1. Emergency Cooling Reservoir. (Arkansas Power and Light Co., Little Rock). 11 May 1973. 3p. Dep. NTIS $3.00.

10408 (DOCKET-50313-81) ARKANSAS NUCLEAR ONE, UNIT 1. Leak Near A Shop Weld. (Arkansas Power and Light Co., Little Rock). 6 Jun 1973. 2p. Dep. NTIS $3.00.

10409 (DOCKET-50313-82) ARKANSAS NUCLEAR ONE, UNIT 1. Inquiry Report No. 50-313/73-2Q, Motor Control Center, Reversing Starter. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 23 May 1973. 5p. Dep. NTIS $3.00.

10410 (DOCKET-50313-84) ARKANSAS NUCLEAR ONE, UNIT 1. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 6 Jun 1973. 250p. Dep. NTIS $14.50.

10411 (DOCKET-50315-118) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (American Electric Power Service Corp., New York). 16 Mar 1973. 1p. (DOCKET-50316-117). Dep. NTIS. $3.00.

10412 (DOCKET-50315-120) DONALD C. COOK NUCLEAR PLANT, UNIT 1. Inspection Report No. 050-315/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 2 May 1973. 7p. Dep. NTIS $3.00.

10413 (DOCKET-50315-121) DONALD C. COOK NUCLEAR PLANT, UNIT 1. Inspection Report No. 050-315/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 3 May 1973. 15p. Dep. NTIS $3.00.

10414 (DOCKET-50315-122) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Fuel Densification Effects. (Indiana and Michigan Power Co., New York). 3 Jan 1973. 2p. (Docket-50316-119). Dep. NTIS $3.00.

10415 (DOCKET-50317-102) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Vertical and Horizontal Separation of Redundant Electrical Safeguard Channels. (Baltimore Gas and Electric Co., MD). 23 Apr 1973. 5p. (DOCKET-50318-97). Dep. NTIS $3.00.

10416 (DOCKET-50317-103) CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 50-317/73-07. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 8 May 1973. 10p. Dep. NTIS $3.00.

10417 (DOCKET-50321-80) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Shrinkage of The Shotcrete Grout and Welding of The Rebar. (Georgia Power Co., Atlanta). 11 May 1973. 2p. Dep. NTIS $3.00.

10418 (DOCKET-50321-81) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 33. (Georgia Power Co., Atlanta). 9 May 1973. 79p. Dep. NTIS $6.00.

Revised and additional information is presented concerning the reactor site, quality assurance program, control systems, and electrical systems. (DCC)

10419 (DOCKET-50324-80) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Request for Antitrust Information, United States Department of Justice. (Department of Justice, Washington, D. C. Antitrust Div.). 29 Jan 1973. 2p. (DOCKET-50325-81). Dep. NTIS $3.00.

10420 (DOCKET-50329-37) MIDLAND PLANT, UNITS 1 AND 2. Limitorque Valve Operators. (Consumers Power Co.,

Jackson, Mich.). 21 Feb 1973. 1p. (DOCKET-50330-36). Dep. NTIS $3.00.

10421 (DOCKET-50329-38) MIDLAND PLANT, UNITS 1 AND 2. Circuit Breakers. (Consumers Power Co., Jackson, Mich.). 13 Apr 1973. 1p. (DOCKET-50330-37). Dep. NTIS $3.00.

10422 (DOCKET-50329-39) MIDLAND PLANT, UNITS 1 AND 2. Inspection Reports Nos. 050-329/73-02 and 050-330/73-02. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 15 May 1973. 7p. (DOCKET-50330-38). Dep. NTIS $3.00.

10423 (DOCKET-50329-40) MIDLAND PLANT, UNITS 1 AND 2. Construction Permit CPPR-81, Amendment 1; Construction Permit CPPR-82, Amendment 1. (Directorate of Licensing (AEC), Washington, D. C.). 23 May 1973. 8p. (Docket-50330-39). Dep. NTIS $3.00.

10424 (DOCKET-50331-97) DUANE ARNOLD ENERGY CENTER. Inspection Report No. 050-331/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 17 Apr 1973. 13p. Dep. NTIS $3.00.

10425 (DOCKET-50331-98) DUANE ARNOLD ENERGY CENTER. NELIA Policy NF-214. (Iowa Electric Light and Power Co., Cedar Rapids). 4 May 1973. 1p. Dep. NTIS $3.00.

10426 (DOCKET-50333-94) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Revised Operating Pressure and Temperature Limits. (Power Authority of the State of New York). 13 Oct 1973. 2p. Dep. NTIS $3.00.

10427 (DOCKET-50333-95) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Reactor Vessel Head Incident. (Power Authority of the State of New York). 12 Apr 1973. 5p. Dep. NTIS $3.00.

10428 (DOCKET-50333-96) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 21. (Power Authority of the State of New York; Niagara Mohawk Power Corp., Lycoming, N. Y.). 25 May 1973. 389p. Dep. NTIS $21.50.

A completely revised Appendix B (Technical Specifications) is presented to replace the existing Appendix B. (FS)

10429 (DOCKET-50334-61) BEAVER VALLEY POWER STATION, UNIT 1. Draft Environmental Statement, Comments of Department of Transportation, United States Coast Guard. Department of Transportation, Washington, D. C.). 27 Apr 1973. 2p. Dep. NTIS $3.00.

10430 (DOCKET-50334-65) BEAVER VALLEY POWER STATION, UNIT 1. Draft Environmental Statement, Comments of Soil Conservation Service and Forest Service. (Department of Agriculture, Washington, D. C.). 7 May 1973. 3p. Dep. NTIS $3.00.

10431 (DOCKET-50334-69) BEAVER VALLEY POWER STATION, UNIT 1. Draft Environmental Statement, Comments of Federal Power Commission. (Federal Power Commission, Washington, D. C. Bureau of Power). 16 May 1973. 5p. Dep. NTIS $3.00.

10432 (DOCKET-50336-60) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Possible Damage to Reactor Core Barrel. (Millstone Point Co., Hartford, Conn.). 26 Apr 1973. 3p. Dep. NTIS $3.00.

10433 (DOCKET-50336-61) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Moisture in 5Kv Stranded Power Cable. (Millstone Point Co., Hartford, Conn.). 15 May 1973. 4p. Dep. NTIS $3.00.

10434 (DOCKET-50341-56) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Westinghouse Circuit Breakers. (Detroit Edison Co., Mich.). 14 Mar 1973. 1p. Dep. NTIS $3.00.

10435 (DOCKET-50344-64) TROJAN NUCLEAR PLANT. Draft Environmental Statement, Comments of Federal Power Commission. (Federal Power Commission, Washington, D. C. Bureau of Power). 11 Jun 1973. 7p. Dep. NTIS $3.00.

10436 (DOCKET-50346-59) DAVIS-BESSE NUCLEAR POWER STATION. Preoperational Environmental Monitoring Program. (Toledo Edison Co., Ohio). 11 Jun 1973. 21p. Dep. NTIS $3.25.

10437 (DOCKET-50348-60) JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 1. Fire in Protective Covering on Upper Internals. (Alabama Power Co., Birmingham). 8 May 1973. 4p. Dep. NTIS $3.00.

10438 (DOCKET-50352-37) LIMERICK GENERATING STATION, UNITS 1 AND 2. Applicant's Environmental Report, Supplement 3. (Philadelphia Electric Co., PA). 25 May 1973. 17p. (DOCKET-50353-37). Dep. NTIS $3.00.

10439 (DOCKET-50352-39) LIMERICK GENERATING STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Delaware River Basin Commission. (Delaware River Basin Commission, Trenton, N.J. (USA)). 6 Jun 1973. 33p. (DOCKET-50353-39). Dep. NTIS $3.75.

10440 (DOCKET-50354-40) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Delaware River Basin Commission. (Delaware River Basin Commission, Trenton, N. J. (USA)). 6 Jun 1973. 35p. (DOCKET-50355-39). Dep. NTIS $3.75.

10441 (DOCKET-50361-40) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Certificate of Conformance with Water Quality Standards. (California State Water Resources Control Board, Sacramento (USA)). 26 Apr 1973. 30p. (DOCKET-50362-39). Dep. NTIS $3.50.

10442 (DOCKET-50361-42) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Draft Environmental Statement, Comments of the Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 18 May 1973. 2p. (DOCKET-50362-41). Dep. NTIS $3.00.

10443 (DOCKET-50363-51) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Applicant's Proposed Supplemental Findings Related to Water Quality Considerations. (Jersey Central Power and Light Co., Morristown, N. J.). 14 May 1973. 20p. Dep. NTIS $3.00.

10444 (DOCKET-50367-41) BAILLY GENERATING STATION, NUCLEAR 1. Final Environmental Statement, Errata. (Northern Indiana Public Service Co., Hammond). 22 May 1973. 1p. Dep. NTIS $3.00.

10445 (DOCKET-50389-19) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Volume 8. (Florida Power and Light Co.). 15 May 1973. 196p. Dep. NTIS $12.00.

Information on the technical specifications and the quality assurance program at the St. Lucie Plant, Unit 2, is presented. (JWR)

10446 (DOCKET-50389-20) ST. LUCIE PLANT, UNIT 2. Application for Licenses. (Florida Power and Light Co.). 14 May 1973. 79p. Dep. NTIS $6.00.

The application for a construction permit and operating license for the St. Lucie Power Reactor Unit 2 is presented. Financial data on the owners of the reactor are included. (DCC)

10447 (DOCKET-50395-44) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Inspection Report No. 50-395/73-1. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 16 Apr 1973. 16p. Dep. NTIS $3.00.

10448 (DOCKET-50395-45) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Construction Permit No. CPPR-94, Amendment 1. (Directorate of Licensing (AEC), Washington, D.C.). 29 May 1973. 5p. Dep. NTIS $3.00.

10449 (DOCKET-50400-44) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Emergency Traffic Plan. (Carolina Power and Light Co., Raleigh, N. C.). 15 May 1973. 11p. (DOCKET-50401-44; DOCKET-50402-44; DOCKET-50403-44). Dep. NTIS $3.00.

10450 (DOCKET-50409-52) LA CROSSE BOILING WATER REACTOR FUEL DENSIFICATION EFFECTS. (Dairyland Power Cooperative, La Crosse, Wis.). 21 May 1973. 34p. Dep. NTIS $3.75.

10451 (DOCKET-50410-29) NINE MILE POINT NUCLEAR STATION, UNIT 2. Environmental Report, Confirmation of Supplement 4. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 11 May 1973. 2p. Dep. NTIS $3.00.

10452 (DOCKET-50410-30) NINE MILE POINT NUCLEAR STATION, UNIT 2. Draft Environmental Statement, Comments

of Federal Power Commission. (Federal Power Commission, Washington, D. C. Bureau of Power). 23 May 1973. 5p. Dep. NTIS $3.00.

10453 (DOCKET-50410-31) NINE MILE POINT NUCLEAR STATION, UNIT 2. Draft Environmental Statement, Comments of United States Environmental Protection Agency. (Environmental Protection Agency, Washington, D. C. (USA)). 25 May 1973. 18p. Dep. NTIS $3.00.

10454 (DOCKET-50412-12) BEAVER VALLEY POWER STATION, UNIT 2. Draft Environmental Statement, Comments of United States Coast Guard. (Coast Guard, Washington, D. C.). 15 May 1973. 2p. Dep. NTIS $3.00.

10455 (DOCKET-50412-13) BEAVER VALLEY POWER STATION, UNIT 2. Draft Environmental Statement, Comments of Department of Agriculture. (Department of Agriculture, Washington, D. C.). 16 May 1973. 2p. Dep. NTIS $3.00.

10456 (DOCKET-50412-14) BEAVER VALLEY POWER STATION, UNIT 2. Draft Environmental Statement, Comments of Applicant. (Duquesne Light Co., Pittsburgh, PA). 22 May 1973. 27p. Dep. NTIS $3.00.

10457 (DOCKET-50412-16) BEAVER VALLEY POWER STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 5. (Duquesne Light Co., Pittsburgh, PA). 4 May 1973. 149p. Dep. NTIS $9.50.

Revised and requested information is presented concerning the containment system, engineered safeguards, auxiliary systems, site, and protection systems. (DCC)

10458 (DOCKET-50412-17) BEAVER VALLEY POWER STATION, UNIT 2. Draft Environmental Statement, Comments of Advisory Council on Historic Preservation. (Advisory Council on Historic Preservation, Washington, D. C. (USA)). 22 May 1973. 1p. Dep. NTIS $3.00.

10459 (DOCKET-50413-22) CATAWBA NUCLEAR STATION. Environmental Report, Amendment 2. (Duke Power Co., Charlotte, N. C.). 18 May 1973. 131p. (DOCKET 50414-22). Dep. NTIS $8.75.

10460 (DOCKET-50416-25) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Advisory Council on Historic Preservation. (Assvisory Council on Historic Preservation, Washington, D. C. (USA)). 11 May 1973. 2p. (DOCKET-50417-25) Dep. NTIS $3.00.

10461 (DOCKET-50423-14) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Applicant's Environmental Report, Amendment 3. (Millstone Point Co., Hartford, Conn). 18 May 1973. 56p. Dep. NTIS $5.00.

10462 (DOCKET-50424-13) ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Environmental Report, Amendment 1. (Georgia Power Co., Atlanta). 4 May 1973. 224p. (DOCKET-50425-13; DOCKET-50426-13; DOCKET-50427-13). Dep. NTIS $13.25.

10463 (DOCKET-50434-1) SURRY POWER STATION, UNITS 3 AND 4. License Application. (Virginia Electric and Power Co., Richmond). 29 May 1973. 119p. (DOCKET 50435-1). Dep. NTIS $8.00.

License applications for the construction and operation of the Surry Power Reactor Units 3 and 4 are presented. Financial data on the owners of the reactors are included. (DCC)

10464 (DOCKET-50434-2) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Volume 1. (Virginia Electric and Power Co., Richmond). 1973. 402p. (DOCKET-50435-2). Dep. NTIS $22.25.

Information on the Surry Power Reactor Units 3 and 4 is presented concerning general design parameters and site characteristics. (DCC)

10465 (DOCKET-50434-4) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Volume 3. (Virginia Electric and Power Co., Richmond). 1973. 505p. (DOCKET-50435-4). Dep. NTIS $27.25.

Information on the Surry Power Reactor Units 3 and 4 is presented concerning design criteria for structures, components, equipment, and systems. (DCC)

10466 (DOCKET-50434-5) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Volume 4. (Virginia Electric and Power Co., Richmond). 1973. 405p. (DOCKET-50435-5). Dep. NTIS $22.25.

Information on the Surry Power Reactor Units 3 and 4 is presented concerning thermal and hydraulic characteristics, and cooling system. (DCC)

10467 (DOCKET-50434-6) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Volume 5. (Virginia Electric and Power Co., Richmond). 1973. 510p. (DOCKET-50435-6). Dep. NTIS $27.50.

Information on the Surry Power Reactor Units 3 and 4 is presented concerning engineered safeguards, instrumentation, control systems, and electrical systems. (DCC)

10468 (DOCKET-50434-7) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Volume 6. (Virginia Electric and Power Co., Richmond). 1973. 461p. (DOCKET-50435-7). Dep. NTIS $25.25.

Information on the Surry Power Reactor Units 3 and 4 is presented concerning auxiliary systems and power conversion system. (DCC)

10469 (DOCKET-50434-8) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Volume 7. (Virginia Electric and Power Co., Richmond). 1973. 453p. (DOCKET-50435-8). Dep. NTIS $24.75.

Information on the Surry Power Reactor Units 3 and 4 is presented concerning radioactive waste management, radiation protection, operations aspects, initial tests and operation, and accident analysis. (DCC)

10470 (DOCKET-50434-9) SURRY POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Volume 8. (Virginia Electric and Power Co., Richmond). 1973. 340p. (DOCKET-50435-9). Dep. NTIS $19.00.

Information on the Surry Power Reactor Units 3 and 4 is presented concerning technical specifications and quality assurance program. (DCC)

10471 IS IT ADMISSIBLE TO REQUIRE ENGINEERED SAFETY MEASURES FOR THE PROTECTION OF NUCLEAR FACILITIES FROM HYPOTHETICAL EXTERNAL EFFECTS? Mutschler (Univ., Muenster, Ger.). (1972). vp. (In German).

From first symposium on atomic energy law; Muenster, Germany (7 Dec 1972).

The question is discussed as to whether engineered safety measures for the protection of nuclear facilities from hypothetical external effects ought to be required at the time of the licensing of a plant, i.e. at a time when a potential aggravation of risks due to external effects cannot be anticipated or realized. A potential aggravation of risks might, for instance, be brought about by the fact that new industrial plants emitting radioactive substances are built next to an installed nuclear power plant, thus presenting a danger to the plant already in operation. The safety measures to be taken in this case (which is cited as an example out of many other hypothetical cases) are discussed by referring to paragraph 7 of the Atomic Energy Law and other pertinent provisions. (GF)

GENERAL

Civilian Defense

Refer also to abstracts 8144 and 8190.

10472 RESEARCH ON REMOVING RADIOACTIVE FALLOUT FROM FARMLAND. Contract AT(49-7)-1527). Technical Bulletin No. 1464. Beltsville, MD; Department of Agriculture (1973). 38p. GPO $0.35.

A research project on the removal of radioactive fallout from farmland was conducted under AEC contract by the U. S. Department of Agriculture. Methods were devised to simulate both wet and dry fallout, and methods of removal were devised. The radioactivity eliminated from farmland by removal of various contaminated crops was measured. Following this, the effectiveness of removing contaminated top soil was determined. In a related study, the contaminated soil was treated with a concrete or asphalt coating before removal. Road graders, bulldozers, rotary and elevating scrapers, as well as mechanized street-sweepers were used to remove the contamination. Further studies involved burying contaminated soil three feet deep with a large plow and measuring the uptake of radioactivity in various crops planted over it. Factors controlling uptake of radioactivity by crop plants were compared. (CH)

Energy Utilization and Economics

Refer also to abstract 8078.

10473 (AEC-tr-7420) POWER PLANT AND WATER WORKS (PREUSSAG). [nd]. Translation of Kraftwerk und wasserwerk (Preussag). 18p. Dep. NTIS $3.00.

Originally intended only for 15 MW output, two later construction stages took the power plant to 100 MW by May 2, 1957. After the 100-MW plant was put into operation, the capacity of the water recovery facilities was used up almost entirely; a closed cooling system with air cooling of the circulating cooling condensate was provided for the 150-MW block (3rd stage operational Mar. 28, 1967), making it possible to operate the block with condensation that entails no water loss. The power plant supplies current and steam to the Ibbenburen mining operation and current supply to Electrochemistry Ibbenburen, in addition to feeding into the public electric supply. Complete outlines of the power plant and water works are presented. (LMT)

10474 (BNL-17800) METHANOL AS A FUEL IN THE URBAN ENERGY ECONOMY AND POSSIBLE SOURCE OF SUPPLY. Steinberg, M.; Salzano, F. J.; Beller, M.; Manowitz, B. (Brookhaven National Lab., Upton, N. Y.). Apr 1973. 20p. Dep. NTIS $3.00.

The potential for the development of methanol technology as a source of energy in the urban economy is discussed. The manufacturing technology involves the conversion of coal to gasoline or other liquid petroleum products, the conversion to some synthetic liquid fuel forms such as methanol or ammonia, and the conversion of coal to a gaseous fuel such as natural gas or hydrogen. The technology for the synthesis of methanol is readily available and involves production by reforming methane, petroleum, or gasification of coal. The processes for the production of methanol are discussed and the economic feasibility is presented. (JCW)

10475 (BNWL-SA-4666) WATER REUSE IN POWER PRODUCTION. An Overview. Jaske, R. T. (Battelle Pacific Northwest Labs., Richland, Wash.). 25 Apr 1973. 29p. (CONF-730433-2). Dep. NTIS $3.50.

From national conference on complete water use; Washington, District of Columbia, USA (23 Apr 1973).

The energy use expansion is directly related to the water resources in the nation. Consumptive water requirements of energy growth is discussed in its relationship with energy conversion and generation on consumptive use patterns, competition for available supply, and problems brought about by flow variations resulting from the use of hydro-peaking. A discussion is included from a question on whether the nation can afford the environmental consequences of unlimited energy use fostered by policies that emphasize low price. (JCW)

10476 (ORNL-EIS-73-52(Vol.1)(No.5)) NSF–RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (ed.). (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 40p. Dep. NTIS $4.00.

The May 1973 compilation of NSF–RANN Energy Abstracts contains 144 abstracts covering research on energy sources, electric power (generation, supply and demand, transmission, environmental effects, and use), and energy (production, consumption, supply and demand, and policy). The research publications cited are technical journal articles, popular or semi-technical magazine articles, topical reports, progress reports, symposium papers and proceedings, monographs, and books published within the past two years. (JCW)

10477 (ORNL-TM-4187) CRYOGENIC DIELECTRICS AND SUPERCONDUCTING AND CRYOGENIC MATERIALS TECHNOLOGY FOR POWER TRANSMISSION. Semiannual Report, March 1, 1973. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 139p. Dep. NTIS $9.00.

The cryogenic dielectrics, superconducting, and cryogenic materials program at ORNL was funded Nov. 1, 1972. The report covers research performed Nov. 1 through Feb. 28. Cryogenic and superconducting cables that operate at temperatures from 90K down to 4K are being developed with the expectation of power capabilities from four to ten times that of present-day cables and with substantial reductions in investment. The research involves dielectrics for electrical insulation, metals for the superconducting superconductor, and normal conducting substrate. The dielectrics proposed for the developmental cables include vacuum, liquids, gases, and solids, but the experimental investigations of dielectrics at low temperatures have been so few that the cable developments are proceeding with such meager understanding of the dielectric phenomena at low temperatures that otherwise very expertly proposed developments are in danger of failure. The conductors, both superconducting and normal, are those materials that have been studied extensively for use in dc or slowly pulsed magnets or in microwave equipment such as accelerators but which have not been optimized for power transmission whether dc or ac. (JCW)

10478 HYDROGEN ECONOMY CONCEPT. Gregory, D. Pub. Util. Fortn.; 91: No. 12, 57-59(7 Jun 1973).

The Institute of Gas Technology has been conducting a study of the synthetic chemical fuel that can be produced from nuclear or solar energy and other readily available sources: hydrogen. Hydrogen can be produced from water by the addition of energy and can be oxidized back to water to give up this energy as heat or electric power directly. It is the perfect ecology fuel, a pollution-free recyclable fuel. Water can be converted to hydrogen and oxygen in three ways. Hydrogen can be stored in underground reservoirs or liquefied and stored in insulated tanks the same way that natural gas is stored today. Defined safety codes have been established for the use and storage of hydrogen. The economics for the development of hydrogen as a fuel is discussed. (JCW)

10479 ENERGY: CRISIS AND CHALLENGE. Friedlander, G. D. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 10: No. 5, 18-27(May 1973).

Availability, production technologies, and economics of fuels for energy generation are discussed. Data pertaining to the crises for now, 1985, 1990, and the year 2000 are outlined. Energy requirements are presently furnished by oil, 43%; natural gas, 33%; coal, 20%; and the remainder is furnished by nuclear and hydroelectric power and solar and geothermal energy. The blame for the fuel shortages and their certain, adverse impact on the economy can be placed at several doors: government, regulatory agencies, suppliers, and the general public. Coal remains in fairly good supply, and it seems that production and use of coal will have to be increased, although it is responsible for pollution of the atmosphere in many areas and restoration of the landscape from strip-mining is a problem. (JCW)

10480 GAS SHORTAGE. Tybout, R. A. (Ohio State Univ., Columbus). Pub. Util. Fortn.; 91: No. 12, 24-29(7 Jun 1973).

Natural gas regulation is entering a phase in which traditional concepts of rate adjustment appear inadequate. The evidence for this view is the Federal Power Commission's projection of an increasing long-term gap between demand and supply of natural gas. Although possessed of traditional rate-making authority, FPC appears unable to establish market clearing prices and is planning instead to rely on rationing over the next two decades. The prospect is unprecedented and calls for a basic reconsideration of public policy. (auth)

10481 FUTURE SUPPLY AND DEMAND FOR ELECTRICITY IN CANADA. Bell, E. S. (National Energy Board, Ottawa); Slader, G. Y. Eng. J. (Montreal); 55: No. 10, 15-21(Oct 1972).

Forecasts are made of electricity consumption in Canada until 2000 AD. The forecasts take account of a decrease in the birth-rate of 17.3 per thousand in 1970. Forecast consumptions are 389 TWh in 1980 and 1,315 in 2000. The latter figure corresponds to 38 MWh/a per capita. Canada comes second only to Norway in consumption of electricity. Some possibilities for increased use of electricity in the home are indicated. New hydroelectric power sites will be developed in Manitoba, British Columbia, Yukon, Quebec and Labrador. Only in British Columbia will consumption of coal increase much. Ontario will achieve increased production of electricity mainly from nuclear energy. Nuclear capacities predicted for 2000 AD for Ontario, Maritimes, Quebec, Prairies, B. C. (and the territories) are 371, 18, 175, 0, 56 TWh/a; the corresponding figures for 1980 are 35, 0, 1.75, 0, 0. (CA)

10482 CERTAIN BACKGROUND INFORMATION FOR CONSIDERATION WHEN EVALUATING THE NATIONAL ENERGY DILEMMA. Prepared at the Request of Melvin Price, Chairman, Joint Committee on Atomic Energy by Staff of JCAE, Ninety Third Congress, First Session. Washington, DC; Joint Committee on Atomic Energy (1973). 37p. GPO $1.85.

A graphic presentation was prepared by the staff of the Joint Committee on Atomic Energy to obtain a reasonable understanding of the broad problems, scale, and complexity of the energy dilemma. A method was devised for visually displaying projected future effects of various energy policies on the domestic energy situation. (JCW)

Information Handling

10483 (CONF-711010-) INTERACTIVE BIBLIOGRAPHIC SYSTEMS. Proceedings of a Forum Held at Gaithersburg, Maryland, October 4–5, 1971. AEC Symposium Series 28. Henderson, M. B. (ed.) (National Bureau of Standards, Washington, D. C.). Apr 1973. 211p. Dep. NTIS $7.60.

The following talks are included: (1) use of RECON, (2) terminal requirements for interactive bibliographic retrieval, (3) comparison of retrieval using controlled-vocabulary indexing and machine-indexed text, (4) some good and bad features of present and future systems, (5) techniques and tools for improving the interactive system interface, (6) on-line input of textual data, (7) the defence RDTE on-line system, (8) computer hardware, (9) design considerations in developing on-line interactive bibliographic systems, (10) communications for on-line bibliographic systems, (11) interactive information systems: selection and performance evaluation, (12) economics of on-line information retrieval, (13) remote evaluation of a remote-console information-retrieval system (NASA/RECON), (14) future developments, (15) emerging management considerations affecting interactive systems, (16) ease of use as an acceptance factor in interactive search systems, (17) insights in implementing the redesign cycle, and (18) evolution and future of computer-assisted information retrieval. (MOW)

10484 (INDC-11-U) TECHNICAL MINUTES OF THE FIFTH INDC MEETING, IAEA HEADQUARTERS, VIENNA, AUSTRIA, JULY 17–21, 1972. Joly, R. (comp.) (International Nuclear Data Committee). Apr 1973. 129p. Dep. NTIS (U. S. Sales Only) $8.50.

Information of a technical nature presented and discussed at the meeting is included for distribution to scientists interested in the production, evaluation, and use of nuclear data. (LMT)

10485 (SLA-73-133) DEVLIB: A PDP-10 SEMICONDUCTOR DEVICE LIBRARY PROGRAM. Case, G. R.; Meland, J. B. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 62p. Dep. NTIS $3.00.

This report describes an interactive computer program which can search a data file to locate semiconductor devices which meet user-supplied requirements. The method of data entry, the program structure, and the library service routines are described. (auth)

Law

10486 NUCLEAR PROBLEMS AND INTERNATIONAL RELATIONS. Berlia, G. Paris; Les Cours de Droit (1972). 138p. (In French).

The difference between the nuclear weapons age and the past is discussed. An attempt is made to discover the manner in which the nuclear age has orientated international relations. The national politics of nuclear powers are reviewed. The Moscow treaty of the 5th of August 1963 on the partial banning of nuclear experiments, the nonproliferation of nuclear weapons treaty of July 1968, and the SALT talks are presented. (FR)

Management

10487 (CONF-700124-, pp 217-252) RADIATION PROTECTION STANDARDS. Rogers, L. (Atomic Energy Commission, Washington, DC). 1 Nov 1970.

From environmental radioactivity symposium; Baltimore, Maryland, USA (19 Jan 1970).

In environmental radioactivity symposium.

The Atomic Energy Commission's Regulatory Program is carried out under the direction of the Director of Regulation, who reports directly to the five-member Commission. The regulatory program consists of a very comprehensive system of licensing and regulation. Any person who desires to use by-product, source, or special nuclear material or construct and operate a nuclear facility (nuclear power reactor, chemical reprocessing plant, etc.) must obtain a license from the Commission prior to engaging in that activity. This licensing process involves a thorough review and evaluation of such matters as safety organization, design of equipment, safety procedures, and monitoring activities. The Compliance program consists of follow-up inspections to assure that licenses comply with all conditions of their licenses and the Commission's regulations. The regulations and the standards for protection against radiation set forth the rules and conditions for carrying out these activities. The system under which these radiation protection standards were developed and the validity of the system that has resulted in present standards for control of release of radioactivity to the environment are discussed. (CH)

10488 (CONF-700124-, pp 253-269) TECHNOLOGICAL DECISION MAKING. Wolman, A. (Johns Hopkins Univ., Baltimore). 1 Nov 1970.

From environmental radioactivity symposium; Baltimore, Maryland, USA (19 Jan 1970).

In environmental radioactivity symposium.

Problems encountered in the administrative management of programs for the development of peaceful uses of atomic energy are reviewed. The basis for the development of standards for the radiation protection of the human population in the USA is discussed. The responsibility of the AEC with regard to the design, construction, operation, and general management of all nuclear plants, including reactors and fuel processing plants, is reviewed. (CH)

10489 (INIS-mf-465) ATOMIC ENERGY NATIONAL COMMISSION ANNUAL REPORT, 1970. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 217p. (In Spanish). INIS.

The principal activities of the Comision Nacional de Energia Atomica during 1970 are emphasized, according to the assigned tasks and within the plans outlined for the Argentina nuclear plan for the period 1970–1980. The work completed by the various agencies and principal organizations, the central headquarters, and the atomic center constituents at Ezeiza and Bariloche is discussed. The construction of the nuclear power plant at Atucha makes it possible to analyze the energy program as well as the participation of the national industry in the above-mentioned project and in studies of the feasibility of nuclear power plants (Cordoba), including the relation to ship propulsion. Special mention is also made of the work of the Department of Metallurgy, the preparation of labeled compounds, the use and application of radioisotopes, the training and qualification of personnel through courses and seminars, the economic and financial management, and the necessary logistic support for the accomplishment of such objectives. The account refers also to the related publications that were edited, both for the Commission in the period indicated and for the personnel in various domestic and foreign publications, giving a collection of 230 bibliographic references covering large areas of material. (tr-auth)

10490 (NP-19703) ANNUAL REPORT, 1970. (Commissariat a l'Energie Atomique, Paris (France)). 1970. 60p. (In French). Dep. NTIS (U.S. Sales Only) $5.00.

After a brief introduction, activities are reported under the following: fundamental research; energy generators (reactors and naval propulsion); general studies of technology (energy conversion, desalination, applied chemistry and chemical engineering, etc.); military applications; artificial radioelements, stable isotopes, and utilization of radiations; production of basic materials of the nuclear industry; protection and safety; technology in support of research; effective and general infrastructure of CEA; finances; CEA relations with industry; international and public relations; education; and charts of organization and composition of committees, councils, and consultative commissions. (LMT)

10491 (NP-19746) ANNUAL REPORT OF THE DEPARTMENT OF ATOMIC ENERGY, GOVERNMENT OF INDIA, 1972–73. (Department of Atomic Energy, Bombay (India)). 1973. 200p.

Dep. NTIS (U. S. Sales Only) $12.00.

A brief description was given of the atomic energy establishments in India. A general survey covered data on nuclear power stations, radioisotopes, nuclear medicine, biology and agriculture, heavy water projects, nuclear fuel, the support industries, and participation in the IAEA. Activities at the Bhabha Atomic Research Centre, Reactor Research Centre, High Altitude Research Laboratory, Atomic Minerals Division, Tata Memorial Centre, Tata Institute of Fundamental Research, Saha Institute of Nuclear Physics, and Nuclear Fuel Complex are reported. All progress made on projects dealing with nuclear power, industrial operations, and heavy water projects were reported. The funding of educational projects, symposia, and nuclear-industry-related housing are discussed. The Programme Analysis Group provides planning and consulting services to all units under the AEC, India. International relations are discussed. (JCW)

10492 (NP-19777) ANNUAL REPORT, 1972. (National Inst. for Metallurgy, Johannesburg (South Africa)). 1972. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

Brief reports are included from the following Divisions: Process Development; Ore-Dressing; Economics and Costing; Mineral and Process Chemistry; Instruments; Mineralogy; Analytical Chemistry; Liaison and Information; and Administration. Unrestricted reports issued and papers submitted for publication during 1972 are listed. Work undertaken by the Institute on uranium and other "nuclear" elements under contract to the South African Atomic Energy Board is only briefly referenced, since that work is reported fully in the annual report of that institution. (LMT)

Mathematics and Computers

10493 (AECD/COM-1) FUNCTIONAL MODELS FOR COMPUTER DESIGN. Khan, M. S. (Atomic Energy Centre, Dacca (Pakistan)). Jan 1973. 45p. Dep. NTIS (U. S. Sales Only) $4.25.

10494 (ANL-7838) APPLIED MATHEMATICS DIVISION SUMMARY REPORT, JUNE 1972. (Argonne National Lab., Ill.). 1972. Contract W-31-109-eng-38. 83p. Dep. NTIS $5.45.

This report is intended to reflect the activities of primary importance to the programs of the U. S. Atomic Energy Commission and Argonne National Laboratory. The activities of FY 1971 and 1972 and highlights of the previous two years are described. The principal activities reported are: computer research and development; mathematics program, which has been focused on two main areas of investigation; mathematical physics and computational mathematics; programming research and collaborative research with other Argonne divisions. Certain activities within the Computer Center are also described. Among them is the development of the RESCUE Timesharing System and the recent acquisition of an IBM/360 Model 195 computer system. In addition, the activities of the Argonne Code Center are reported. (auth)

10495 (COO-2271-5) ENDPOINT DISTRIBUTION OF SELF-AVOIDING WALKS. Grishman, R. (Columbia Univ., New York. Dept. of Physics). 19p. Dep. NTIS $3.00.

The dimerization algorithm for the generation of self-avoiding walks was modified to generate a large number of walks with a relatively large endpoint separation. Walks of up to 512 steps were generated on the square and cubic lattices using this modified algorithm. From these walks the distribution of endpoint x-coordinates of self-avoiding walks was accurately determined over a much larger range than would be possible using earlier techniques. The distributions obtained were found to be in general agreement with those proposed earlier for shorter walks by Domb, Gillis, and Wilmers. (auth)

10496 (HMI-B-132) PROGRAMMING OF A CAMAC BRANCH CONTROLLER FOR AUTONOMOUS INFORMATION TRANSFER WITH AN ON-LINE COMPUTER S 301. Bischoff, M.; Pangritz, H. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). Feb 1973. 48p. (In German). Dep. NTIS (U. S. Sales Only) $4.50.

A CAMAC instrumentation system may be connected with an on-line computer S 301 (Siemens) using a Branch Driver Controller (BDC), which for all information transfers between CAMAC and the computer operates in the direct-memory access mode only. The program for an experiment or a measuring operation therefore consists of one segment, which is executed by the central processor unit of the computer, and a second segment, which is handled in parallel and autonomously by the BDC. This report describes the syntax of a low-level language for the information transfers with the CAMAC instrumentation. There is a preassembler for this low level language, which transforms the complete program, including PROSA commands and statements of this low-level language, in a program with PROSA statements exclusively for further translation by the PROSA assembler. (auth)

10497 (JINR-P2-7068) COVARIANT COORDINATES. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Some problems are discussed concerning the type of transformation formulas for components of 4-momentum p^i and components of the angular momentum 4-tensor M^{ik} in quasi-relativistic (with the accuracy to β^2) and Galilean (nonrelativistic) approximations. Covariant coordinates x_i are introduced which, as is shown, satisfy the space-like transformations. It is shown also that the formed 4-vector $\partial S/\partial x_i$ (in contrast to 4-vector $\partial S/\partial x^i$) has the transformation formulas coinciding with those for p^i. Some problems of nonrelativistic quantum mechanics are considered using the introduced covariant coordinates. (auth)

10498 (KFK-EXT-8/72-4) REGENT SECOND SEMIANNUAL PROGRESS REPORT, APRIL 1972–SEPTEMBER 1972. Enderle, G.; Leinemann, K.; Schlechtendahl, E. G.; Schnauder, H.; Schumann, U.; Schuster, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Dec 1972. 59p. (In German). Dep. NTIS (U. S. Sales Only) $5.00.

Project REGENT was started in early 1972 by the Institut fuer Reaktorentwicklung. Progress achieved in particular in the areas of graphic data processing, simulation, material property data bank, and systems storage and messages control facility is summarized. The expected progress in the next half year period is presented. (26 references) (auth)

10499 (KFK-EXT-8/72-6) KOSPRA: PROPOSAL OF A DESIGN LANGUAGE FOR GEOMETRICAL DESCRIPTION OF TECHNICAL OBJECTS. Leinemann, K.; Schumann, U. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Feb 1973. 104p. (In German). Dep. NTIS (U. S. Sales Only) $7.25.

The principles of describing technical bodies, the main known possibilities to describe these bodies for computer-aided design and the problem related to design languages are investigated. Applications of computer-aided body design and often-used body classes are reported. According to this study a problem-oriented word language "KOSPRA," together with a suitable data structure, was proposed and designed as an extension of the GRAPHIC system. This language enables description of bodies composed of cylindrical primitives ($2^1/_2$ dimensional objects). In KOSPRA a lot of possibilities for description of complex objects and their manipulation and identification are proposed. In the language and data structure the form of bodies and their position are defined separately. The position may be defined by topological constraints. An example and discussion of the usefulness of this language is given. (60 references) (auth)

10500 (KFK-EXT-8/72-7) CAPABILITIES AND IMPLEMENTATION OF THE GRAPHIC LANGUAGE. Enderle, G.; Leinemann, K.; Schlechtendahl, E. G.; Schnauder, H.; Schumann, U.; Schuster, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Dec 1972. 26p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

GRAPHIC is a language for creation, manipulation, and output of graphical objects. The constants of the language are the graphical elements, like points, lines, text, rings or polygons. They can be plotted without further processing. Operations are: intersection of lines, circle through three points, linear transformations or the creations of approximation and spline curves. Names are used for identifying graphical objects. Several objects can be combined into a collection and can be identified by one name. In the GRAPHIC language it is possible to define and invoke subroutines. DO-WHILE and IF-THEN-ELSE-statements are included in the language. GRAPHIC was implemented as a subsystem of the ICES system. The main components of the system are: a language interpreter, a data structure for the internal representation of graphical objects and a number of modules for parsing the data structure, for executing operations and for input and output of graphical information. (auth)

10501 (KFK-EXT-13/72-3) PROGRAM DESCRIPTION OF A PL/1 SUBROUTINE PACKAGE FOR DISCRETE EVENT SIMULATION. Hilse, D.; Rupp, M.; Nehmer, J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Datenverarbeitung in der Technik). Jan 1973. 39p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

A basic subroutine package is described for discrete event simulation in PL/1, that was developed at the "Institut für Datenverarbeitung in der Technik", for use on the IBM 360/370 configuration at the Nuclear Center, Karlsruhe. (auth)

10502 (KFKI-73-6) LAURENT EXPANSION OF THE INVERSE OF A FUNCTION MATRIX. Hegedus, C. J. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Mar 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

A general procedure, based on the Taylor expansion of a function matrix F(z), is described for calculating the Laurent expansion of $F^{-1}(z)$ around an isolated pole. It is shown that, in order to compute the Laurent coefficient matrices B_j of $F^{-1}(z)$, one needs in any case the Taylor coefficients $A_0, A_1, \ldots, A_{2n+j}$ of F(z), where n is the order of the pole. The first theorem helps to decide the order of the pole, while the second shows how the Laurent coefficients may be computed in the general case, too. (auth)

10503 (LBL-1335) FIBONACCI RESIDUE CYCLES. Meissner, L. P. (California Univ., Berkeley. Lawrence Berkeley Lab.). Oct 1972. Contract W-7405-eng-48. 295p. Dep. NTIS $7.60.

An additively generated sequence of nonnegative integers, determined by its modulus and by a pair of generators, forms simply periodic cycles since the generators eventually appear again as a consecutive pair. These cycles (which are called "Fibonacci residue cycles" by analogy to the classical additively generated sequence {0, 1, 1, 2, 3, 5, 8, 13, 21, ...}) partition the pairs of nonnegative integers less than the modulus into equivalence classes of generators, since any consecutive pair of integers occurring in a given cycle can be used as generators for the same cycle. Interpreting each consecutive integer pair as a point in two dimensions, one can plot each Fibonacci residue cycle as a pattern. In part 1 of this report, all the different patterns that occur with modulus 99 or less are systematically displayed. Part 2 consists of a table giving the smallest generator pair for each of the disjoint cycles, up to modulus 255. (auth)

10504 (ORNL-4876) PERCENTAGE POINTS OF MOMENT ESTIMATORS WHICH ARE RATIOS WITH AN APPLICATION TO THE SHAPE PARAMETER OF THE GAMMA DISTRIBUTION. Dusenberry, W. E.; Bowman, K. O. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 205p. Dep. NTIS $3.00.

10505 (ORO-3443-44) NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS. Babuska, I. (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Mar 1973. Contract AT(40-1)-3443. 26p. (CONF-730429-1; BN-761). Dep. NTIS $3.50.

From annual meeting of the Society for Applied Mathematics and Mechanics; Munich, F.R. Germany (2 Apr 1973).

Some ideas and results, primarily when the finite-element method is used, are presented here. (38 references) (LMT)

10506 (RT/ING-(72)16) DESCRIPTION OF THE COMPUTER PROGRAMS OF FINITE ELEMENTS SAFE-3D IN THE IBM-360 VERSION. Massini, G.; Pepino, A.; Serchia, L.; Zaccarelli, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Divisione Affari Internazionali e Studi Economici). 20 Jul 1972. 46p. (In Italian). Dep. NTIS (U. S Sales Only). $4.50.

10507 (SLA-73-386) SAGS: STAND-ALONE GRAPHICS SOFTWARE FOR THE PDP-9/VECTOR GENERAL SYSTEM. Borgman, C. R. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 60p. Dep. NTIS $3.00.

The software package described for the PDP-9 computer consists of Fortran-callable subroutines which generate a display file for the Vector General display scope and turn the display on or off, and which are capable of enabling and detecting light pen hits. (auth)

10508 (UCID-30060) BANDED LINEAR SYSTEMS WITH PIVOTING. Hindmarsh, A. C. (California Univ., Livermore. Lawrence Livermore Lab.). May 1973. Contract W-7405-eng-48. 27p. Dep. NTIS $3.50.

Two subroutine packages are described for the direct solution of a system of linear equations in which the coefficient matrix is real and banded along the main diagonal. In each package, the method of LU decomposition with partial pivoting is applied to the matrix, and the solution of the linear system is then obtained by back substitution in a separate routine. The band structure need not be symmetric. The first of the two packages deals with the case where the matrix resides in small-core memory. The second deals with the case where it resides in large-core memory on the CDC 7600. (auth)

10509 (UCRL-51361) COMPUTER PROGRAM UKO. Ratcliffe, A. E.; White, J. W. (California Univ., Livermore. Lawrence Livermore Lab.). 29 Mar 1973. Contract W-7405-eng-48. 41p. Dep. NTIS $4.00.

UKO is a computer program that uses the finite-difference method to solve initial-value problems of continuum rock mechanics in one spatial dimension. Planar, cylindrical, and spherical symmetries are allowed. All media are assumed to be isotropic and homogeneous. The name UKO, an acronym for "Underground KO," was chosen to indicate that the code was developed from the KO code and deals with rock mechanics. KO simulates elastic behavior and plastic flow. (auth)

Miscellaneous

10510 (AEC-tr-7416) INVESTIGATION OF THE OPTIMAL PRODUCTION AND TRANSPORT OF AEROSOLS FOR SPECTROCHEMICAL PURPOSES. Kranz, E. Translated from Spectrochim. Acta, Part B; 27: 327-343(1972). 22p. Dep. NTIS.

Theoretical and experimental investigations were made to overcome the electrode-independent introduction of analytical materials into plasmas. The actual physical dependence of nebulization, the transport of aerosols, and interferences and the means to overcome them are discussed. From this it is concluded how aerosol production and transport may be improved and optimized and, to this end, self-developed apparatus is described. (auth)

10511 (ANL-7998) DEVELOPMENT OF HIGH-SPECIFIC-ENERGY BATTERIES FOR ELECTRIC VEHICLES. Progress Report, August 1972-January 1973. Cairns, E. J.; Nelson, P. A.; Gay, E. C.; Steunenberg, R. K.; Walsh, W. J.; Battles, J. E.; Shimotake, H.; Ackerman, J. P.; Kyle, M. L.; Webster, D. S. (Argonne National Lab., Ill.). Apr 1973. Contract W-31-109-eng-38. 98p. Dep. NTIS $5.45.

For National Science Foundation, Washington, D. C.

10512 (BDX-613-821(Rev.)) MOISTURE EFFECTS ON THE THERMOSET MOLDING COMPOUNDS Conway, J. M. (Bendix Corp., Kansas City, MO). Mar 1973. Contract AT(29-1)-613. 19p. Dep. NTIS $3.00.

Moisture absorption in bulk thermosetting molding compounds often causes large increases in the spiral flow length of those compounds and prior to this study was suspected to have caused significant degradation in the physical properties of molded parts. In this study the effects of moisture absorption were determined for three types of molding compounds: a mineral filled epoxy, a cotton-filled phenolic, and a long glass-fiber-filled diallyl phthalate resin compound. Of particular interest were the changes in the mechanical, electrical, and flow properties when varying amounts of moisture were absorbed into the premolded forms of the materials. Test results are described. (auth)

10513 (BNL-17555) GLASS-POLYMER COMPOSITES. Beller, M.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y.). Jan 1973. 25p. Dep. NTIS.

Urban solid waste components are being used as aggregates in the development of structurally strong and durable composite materials. A glass-polymer composite is produced by mixing crushed waste glass with monomer and polymerizing by chemical initiation techniques. Resistance to chemical attack far exceeds concrete. Such pipe was produced and installed in a municipal sewer line on Long Island and cost estimates indicate it comparable with asbestos cement. (JCW)

10514 (BNWL-1651(Pt.1), pp 1-16) PRECIPITATION SCAVENGING OF TRACERS RELEASED INTO FRONTAL STORMS. Atkinson, D. G.; Davis, W. E.; Radke, L. F.; Scott, B. C.; Slinn, W. G. N.; Tanner, T. M.; Thorp, J. M.; Wogman, N. A.; Young, J. A. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

10515 (BNWL-1651(Pt.1), pp 16-19) COMPUTER RESULTS FOR AN IN-CLOUD RELEASE OF INDIUM ON 11 MARCH 1971. Davis, W. E. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

10516 (BNWL-1651(Pt.1), pp 19-22) RAINDROP TRAJECTORIES THROUGH WIND SHEAR Slinn, W. G. N.; Bander, T. J. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

10517 (BNWL-1651(Pt.1), pp 22-25) INITIATION OF THE ICE PHASE IN A SEEDED CLOUD. Alkezweeny, A. J. Dec. 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

10518 (BNWL-1651(Pt.1), pp 25-29) ANALYSIS OF DIFFUSION IN WIND SHEAR. Slinn, W. G. N. Dec 1972.

In annual report for 1971 to the USAEC Division of Biology and Medicine.

10519 (BNWL-1651(Pt.1), pp 36-45) WASHOUT OF RHODAMINE DYE PARTICLES. Dana, M. T. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10520 (BNWL-1651(Pt.1), pp 45-50) AEROSOL PARTICLE SIZE DISTRIBUTIONS IN THE NORTHWEST. Alkezweeny, A. J.; Slinn, W. G. N. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10521 (BNWL-1651(Pt.1), pp 51-55) DRY DEPOSITION OF SEA SALT NUCLEI. Slinn, W. G. N. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10522 (BNWL-1651(Pt.1), pp 56-61) CLOUD CONDENSATION NUCLEI AND VISIBLE POLLUTION IN LOS ANGELES. Alkezweeny, A. J.; Lockhart, T. J. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10523 (BNWL-1651(Pt.1), pp 61-64) FLUCTUATIONS IN TRACE GAS CONCENTRATIONS IN THE TROPOSPHERE. Gibbs, A. G.; Slinn, W. G. N. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10524 (BNWL-1651(Pt.1), pp 65-66) PROGNOSTIC ISENTROPIC TRAJECTORIES. Davis, W. E.; Heffter, J. L.; Smith, M. E. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10525 (BNWL-1651(Pt.1), pp 66-69) HOURLY LOW-LEVEL ISENTROPIC TRAJECTORIES. Davis, W. E. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10526 (BNWL-1651(Pt.1), pp 70-72) CLIMATOLOGICAL MEASUREMENTS ON THE ARID LANDS ECOLOGY RESERVE IN 1971. Thorp, J. M.; Hinds, W. T. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10527 (BNWL-1651(Pt.1), pp 91-99) AIRCRAFT INSTRUMENTATION FOR ATMOSPHERIC RESEARCH. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10528 (BNWL-1651(Pt.1), pp 100-101) TECHNIQUES USED TO STABILIZE TRACER SOLUTIONS FOR AEROSOL GENERATION. Thomas, C. W. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10529 (BNWL-1651(Pt.1), pp 101-103) INEXPENSIVE INFUSION SAMPLER FOR ATMOSPHERIC TRACER STUDIES. Hales, J. M.; Glover, D. W. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10530 (BNWL-1651(Pt.1), pp 110-114) COMPARISON OF MEASURED AND PREDICTED EXPOSURES FROM ELEVATED SOURCES. Woodruff, R. K.; Elderkin, C. E. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10531 (BNWL-1651(Pt.1), pp 114-118) COMPARISON OF MAXIMUM EXPOSURES AT GROUND LEVEL RESULTING FROM SIMULTANEOUS RELEASE OF TRACERS FROM TWO ELEVATIONS. Nickola, P. W. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10532 (BNWL-1651(Pt.1), pp 136-138) TRACER PARTICLE RESUSPENSION CAUSED BY WIND FORCES UPON AN ASPHALT SURFACE. Sehmel, G. A. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10533 (BNWL-1651(Pt.1), pp 138-140) SOIL RESUSPENSION BY SURFACE "CREEP". Sehmel, G. A.; Lloyd, F. D. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10534 (BNWL-1651(Pt.1), pp 141-143) SOIL RESUSPENSION BY "SALTATION." Sehmel, G. A.; Lloyd, F. D. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10535 (BNWL-1651(Pt.1), pp 143-145) AIRBORNE DUST CONCENTRATIONS. Sehmel, G. A.; Lloyd, F. D. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10536 (BNWL-1651(Pt.1), pp 146-147) PARTICLE RESUSPENSION FROM AN ASPHALT ROAD CAUSED BY VEHICULAR TRAFFIC. Sehmel, G. A. Dec 1972.
In annula report for 1971 to the USAEC Division of Biology and Medicine.

10537 (BNWL-1651(Pt.1), pp 148-150) DEPOSITION VELOCITIES IN A WIND TUNNEL. Sehmel, G. A.; Sutter, S. L. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10538 (BNWL-1651(Pt.1), pp 150-153) DEPOSITION VELOCITIES AS A FUNCTION OF PARTICLE CONCENTRATION REFERENCE HEIGHT AND ATMOSPHERIC STABILITY. Sehmel, G. A.; Horst, T. W. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10539 (BNWL-1651(Pt.1), pp 153-154) DEPOSITION VELOCITIES OF RESUSPENDED PARTICLES. Sehmel, G. A. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10540 (BNWL-1651(Pt.1), pp 155-161) MEASUREMENTS AND GRAPHS OF TURBULENCE AUTOCORRELATIONS IN SPACE AND TIME. Elderkin, C. E.; Powell, D. C. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10541 (BNWL-1651(Pt.1), pp 161-170) PROFILE-DERIVED ESTIMATION OF CROSSWIND INTEGRATED EXPOSURE FROM ELEVATED RELEASES: INITIAL MODEL. Powell, D. C.; Elderkin, C. E. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10542 (BNWL-1651(Pt.1), pp 171-173) PROFILE-DERIVED ESTIMATION OF CROSSWIND INTEGRATED EXPOSURE FROM ELEVATED RELEASES: METHOD OF INVESTIGATION. Powell, D. C.; Elderkin, C. E. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10543 (BNWL-1651(Pt.1), pp 174-177) DETERMINATION OF THE VON KARMAN AND KILMOGOROV CONSTANTS FROM MEASUREMENTS OF WIND STRESS AND SPECTRA. Horst, T. W. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10544 (BNWL-1651(Pt.1), pp 177-179) TURBULENCE MEASUREMENTS ON THE BONNEVILLE SALT FLATS. Horst, T. W. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10545 (BNWL-1651(Pt.1), pp 179-182) TURBULENCE MEASUREMENT AND ANALYSIS CAPABILITIES. Elderkin, C. E.; Dunbar, A. G.; Powell, D. C. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10546 (BNWL-1651(Pt.1), pp 183-186) COMPUTER ALGORITHM FOR CORRECTING NONCOSINE RESPONSE IN THE GILL ANEMOMETER. Horst, T. W. Dec 1972.
In annual report for 1971 to the USAEC Division of Biology and Medicine.

10547 (CEA-CONF-2203) MEASUREMENT OF TOTAL DEFORMATIONS INDUCED IN THE COURSE OF FLOW TESTS. Calvet, J. N. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 22p. (In French). (CONF-721221-1). Dep. NTIS (U. S. Sales Only) $3.25.
In the course of this study, the role of the factors that influence the measurement of small deformations in flow have been emphasized. The solution adopted to break away from the criteria imposed is based on two principles: alignment of the stresses trans-

mitted with the axis of the test cylinder and a strict coupling of the measuring device to the test cylinder. Under these conditions the determination of quantities such as the modulus of elasticity (E) and the apparent limit of elasticity in the heated state at the time of starting the flow test make it possible to take into account the dispersion of materials. Furthermore, it agrees with the actual problems that necessitate a good understanding of the total deformations (elastic, plastic, and creep with time). (tr-auth)

10548 (CEA-CONF-2209) APPLICATION OF BOLLMANN THEORY TO INTERGRANULAR STRUCTURE OF BENDING JOINTS IN STAINLESS STEEL. Sainfort, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 26p. (In French). (CONF-720680-1). Dep. NTIS (U. S. Sales Only) $3.50.

From meeting of the French Chemical Society; Grenoble, France (22 Jun 1972).

This study was motivated by the electron micrographs obtained at the laboratory by B. Michaur on flexion joints at large angles of bicrystals of stainless steel. The flexion joints were obtained by bending around a ⟨001⟩ axis in principle common to the two crystals. An attempt has been made to apply the theory of Bollman ("Crystal Defect and Crystalline Interfaces," Springer Verlag, Heidelberg–New York, 1970) in order to determine whether it can take into account the characteristics of these micrographs of which an example is shown. The results are encouraging but must be confirmed by precise measurements of certain parameters indispensable for the theory. (tr-auth)

10549 (CEA-CONF-2211) NONDESTRUCTIVE CONTROL THROUGH FOUCAULT CURRENTS USING THE PRINCIPLE OF FREQUENCY SCANNING. Description of the Techniques and Experimental Results. DuJardin, R.; Samoel, A.; Dufayet, J. P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1972. 11p. (In French). (CONF-721085-1). Dep. NTIS (U. S. Sales Only) $3.00.

From First Scientific Technical Conference of the USSR on Nondestructive Test by Foucaut Currents; Moscow, USSR (25 Oct 1972).

The feasibility of applying the method to nuclear fuel cans is also discussed briefly. (LMT)

10550 (CEA-CONF-2240) STUDY OF THE FAILURE OF SOME INTEGRATED CIRCUITS IN THE SCANNING ELECTRON MICROSCOPE. Masimbert, C. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 16 Oct 1972. 9p. (In French). (CONF-720990-1). Dep. NTIS (U.S. Sales Only) $3.00.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semi conductors; Grenoble, France (27 Sep 1972).

10551 (CEA-CONF-2241) AUTOMATIC SYSTEM FOR MEASUREMENT OF [CARRIER] PROFILE AND MOBILITY BY THE HALL EFFECT AND CONDUCTION IN SILICON. Proth, J. F.; Monnier, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 16 Oct 1972. 27p. (In French). (CONF-720990-4). Dep. NTIS (U. S. Sales Only) $3.50.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semiconductors; Grenoble, France (27 Sep 1972).

10552 (CEA-CONF-2242) STUDY OF THE DISTRIBUTION OF PHENOMENA OF [CARRIER] GENERATION AND RECOMBINATION IN A PLANE JUNCTION. Carme, H.; Monnier, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d' Etudes Nucleaires). 16 Oct 1971. 30p. (In French). (CONF-720990-2). Dep. NTIS (U. S. Sales Only) $3.50.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semiconductors; Grenoble, France (27 Sep 1972).

The physical measurements described, combined with the technology, make it possible to optimize the response of a diode or of a photodiode. In effect, if it is possible to control the diffusion length by measuring the number of traps of given energy, it is then possible to obtain a rate of response chosen in advance as well as also, in the case of a photodiode, the thickness of oxide that allows the filtering of a chosen wavelength. (tr-auth)

10553 (CEA-CONF-2244) DETERMINATION OF THE LIFETIME OF IMPLANTED DIODES BY ELECTRICAL MEASUREMENTS. Combasson, J. L. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 18 Oct 1972. 8p. (In French). (CONF-720990-3). Dep. NTIS (U. S. Sales Only) $3.00.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semiconductors; Grenoble, France (27 Sep 1972).

The combined use of statistical methods with an electric measurement made it possible to determine with precision a parameter characteristic of the behavior of implanted layers. The correlation with the results obtained by other methods makes it possible to describe precisely the ensemble of physical mechanisms put into play in the course of processes of annealing of implanted layers. (tr-auth)

10554 (CONF-730316-1) DEVELOPMENT OF HIGH-VOLTAGE RADIOGRAPHY AND DUAL MICRODENSITOMETRIC TECHNIQUES FOR EVALUATING STRESSED ROCK SPECIMENS. Foster, B. E.; Snyder, S. D.; McClung, R. W.; Godzinsky, W. J. (Oak Ridge National Lab., Tenn.). 1972. 24p. Dep. NTIS.

From conference of the American Society for Nondestructive Testing; Los Angeles, California, USA (12 May 1973).

Radiographic techniques to qualitatively ascertain the performance of expansion anchor roof bolts in cylindrical rock specimens were investigated. High-voltage (2 MeV) radiography was performed on specimens of limestone, shale, and sandstone in both unstressed and stressed conditions. Experiments were conducted for (1) optimizing the techniques for producing the radiographs and (2) making quantitative measurements with microdensitometry on radiographs of stressed and unstressed blocks. (auth)

10555 (COO-841-30) DIFFUSION STUDIES IN LIQUID METALS. Final Report. Swalin, R. A. (Minnesota Univ., Minneapolis. Inst. of Tech.). Apr 1973. Contract AT(11-1)-841. 14p. Dep. NTIS $3.00.

Self-diffusion experimentation in liquid metals was conducted over a wide temperature interval under constant-volume conditions to test models that were based on a variety of possible mechanisms of diffusion in liquid metals. The systematic diffusion of a variety of trace concentrations of solutes in liquid silver was investigated and compared to theoretical predictions and to work on the same systems in the solid state. Thermotransport studies in liquid alloys show that solutes may segregate at either the hot end or the cold end. The thermal segregation of solutes in liquid silver and various alkali metals was investigated. (JCW)

10556 (COO-1794-13) STRENGTHENING AND TOUGHENING OF BRITTLE MATERIALS. Progress Report, January 31, 1972–January 31, 1973. Broutman, L. J.; Mallick, P. K. (Illinois Inst. of Tech., Chicago). [nd]. Contract AT(11-1)-1794. 59p. Dep. NTIS.

The matrix materials in three cases of composite systems were a thermosetting resin, namely, an epoxy. The reinforcing phases include glass beads, milled glass fibers, and a potassium titanate inorganic whisker, Fybex. The effects of the interface, spherical particle size, and fiber length-to-diameter ratio on the composite properties such as fracture toughness, strength, stiffness, and impact resistance were determined. (JCW)

10557 (COO-1794-16) MICROMECHANICS ANALYSIS OF COMPOSITE MATERIALS USING FINITE-ELEMENT METHODS. Agarwal, B. D. (Illinois Inst. of Tech., Chicago). May 1972. Contract AT(11-1)-1794. 160p. Dep. NTIS.

Thesis.

Finite-element methods were used to calculate internal stresses within a spherical particle and discontinuous fiber composite. The internal stresses were analyzed as a function of interparticle spacing, and the elastic constants were calculated from a knowledge of these stresses. The effect of altering the interface properties was simulated by assigning different properties to the finite elements forming the boundary of the interface. (auth)

10558 (COO-3116-5) COINCIDENCE MOESSBAUER STUDIES OF SOLID STATE PHENOMENA. Final Report, June 1, 1968–July 31, 1972. Hoy, G. R. (Boston Univ., Mass.). [nd]. Contract AT(11-1)-3116. 82p. Dep. NTIS $6.25.

Efforts included: development of computer programs for extracting effective field parameters from experimental Moessbauer spectra with thickness and single-crystal effects considered, experimental and theoretical studies of magnetically induced quadrupole interactions, computational and experimental development of delayed-coincidence Moessbauer spectroscopy, and development of a technique for studying relaxation effects called the selective-excitation double Moessbauer effect. (auth)

10559 (COO-3161-10) STATIC AND DYNAMIC PROPERTIES OF SYSTEMS WITH MULTIPOLE INTERACTIONS AND INTERNAL DYNAMIC STRUCTURE. Mandell, M. J. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Feb 1973. Contract AT(11-1)-3161. 133p. Dep. NTIS.

Thesis.

10560 (COO-3280-2) BASIC MECHANISM IN CARCINOGENESIS. Progress Report, May 1972–May 1973. Ts'o, P. O. P.

(Johns Hopkins Univ., Baltimore, Md. Dept. of Radiological Sciences). 1973. Contract AT(11-1)-3280. 12p. Dep. NTIS $3.00.

10561 (COO-3363-2) STUDIES OF LYMPHOCYTE GROWTH AND DIFFERENTIATION. Progress Report, May 1, 1972–April 15, 1973. Rubin, A. D. (Mount Sinai School of Medicine, New York). 1973. Contract AT(11-1)-3363. 17p. Dep. NTIS $3.00.

10562 (COO-3399-1) NEW APPROACHES TO IMAGE FORMATION IN RADIOISOTOPE SCANNING. Progress Report, August 1, 1972–April 27, 1973. Kuhl, D. E. (Pennsylvania Univ., Philadelphia. Dept. of Radiology). 1973. Contract AT(11-1)-3399. 10p. Dep. NTIS $3.00.

10563 (COO-3407-6) TEMPERATURE DEPENDENCE OF THE LONG-RANGE ORDER PARAMETER OF Ni_3Al. Pope, D. P.; Garin, J. L. (Pennsylvania Univ., Philadelphia). [nd]. Contract AT(11-1)-3407. 15p. Dep. NTIS $3.00.

The macroscopic yield stress of Ni_3Al increases rapidly with temperature, reaching a maximum at about 700°C. Such anomalous behavior was observed in other ordered alloys that undergo partial disordering with increasing temperature, e.g., Cu_3Au. The long-range order parameter, S, of stoichiometric Ni_3Al powder was measured over the temperature range 25 to 1000°C. Great care was taken to ensure a fine particle size to avoid extinction effects. The results of this study showed that, in Ni_3Al, S remains constant at about 0.93 over the entire temperature range investigated. This means that theories relating the strength of ordered alloys to S are not applicable to Ni_3Al. (auth)

10564 (DUN-8077) LOEWY EXTRUSION PRESS: REPAIR AND ALIGNMENT 1972. House, E. L. (Douglas United Nuclear, Inc., Richland, Wash.). 13 Nov 1972. 15p. Dep. NTIS $3.00.

The maintenance procedures performed during overhaul of the equipment are outlined. (MOW)

10565 (EUR-4963) MOLP: AN INTERACTIVE SYSTEM FOR MOLECULAR PROPERTIES CALCULATION. Mongini, L.; Pollicini, A. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). May 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25. EUR B.Fr. 40.-.

An interactive system of programs for linked molecular properties calculation, realized at the CETIS computer installation in ISPRA, is described. The selection of the program sequence, the programs execution and transmission of data, are under the control of processor CARONTE. The interactive programs are used with the IBM 2250 Display Unit. The status of the system up to summer 1972 is described. (auth)

10566 (HEDL-SA-225) COMPUTER SIMULATION OF ASYMMETRIC GRAIN BOUNDARIES AND THEIR INTERACTION WITH VACANCIES AND CARBON IMPURITY ATOMS. Dahl, R. E. Jr.; Beeler, J. R. Jr.; Bourquin, R. D. (Wadco Corp., Richland, Wash.; North Carolina State Univ., Raleigh; Battelle Pacific Northwest Labs., Richland, Wash.). Sep 1971. Contract AT(45-1)-1830. 39p. (CONF-711071-1). Dep. NTIS.

Structural studies utilizing computer simulation were used to determine the effects of grain boundaries on point defects. The defects were the simple monovacancy and interstitial impurity atom. The host material was fcc (γ) iron so that the conclusions were qualitatively applicable to stainless steel. The vacancy-grain boundary interactions describe vacancy mechanisms in polycrystalline metals. (JCW)

10567 (IFA-LR-1-1972) TEMPERATURE DISTRIBUTIONS IN SOLIDS BY LASER IRRADIATION. Alexandrescu, R.; Velculescu, V. G. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

The local temperatures produced by laser-beam irradiation are estimated using the Carlslaw–Jaeger method for ten materials (gold, silver, copper, aluminum, lead, iron, granite, glass, wood, and brick) of technological interest and for two-beam diameters. The radiation densities capable of producing specific effects (e.g., melting, burning) on the sample surface are specified. The transient regime before reaching thermodynamic equilibrium inside the irradiated area is also discussed. (auth)

10568 (INT-26(Pt.1)) DESCRIPTION OF SYMMETRY OF MAGNETIC STRUCTURES BY REPRESENTATION OF SPACE GROUPS. Part I. Sikora, W. (Institute of Nuclear Research, Krakow (Poland)). 1972. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The method of describing the symmetry of magnetic structures by representations of space groups is given. It is applied to the description of the symmetry of compounds that belong to the tetragonal system and have identical magnetic and crystal unit cells. The results are compiled. For illustration, the example of Cr_2TeO_6 is calculated in full detail. (tr-auth)

10569 (IPP-4/106) ACTIVELY MODE-LOCKED TEA–CO_2 LASER WITH PULSE SELECTING SYSTEM. Baumhacker, H.; Fill, E.; Hofmeister, F. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Nov 1972. 42p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

A laser oscillator that produces a short pulse of 1.3-nsec duration at a wavelength of 10.6 μ is described. The pulse energy is 5 mJ, the beam divergence 2 mrad. To generate this pulse, a TEA–CO_2 laser is acousto-optically mode locked. From the pulse train produced this way, a single pulse is selected by electro-optic means. (auth)

10570 (ITF-72-186-P) APPLICATION OF A METHOD OF IRREDUCIBLE TENSOR OPERATORS TO THE INVESTIGATION OF ONE-PARTICLE ELECTRIC-DIPOLE TRANSITIONS IN ANTIFERRODIELECTRICS. Petrov, E. G.; Kharkyanen, V. N. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

A method of irreducible tensor operators is used to construct a theory of one-particle spin-forbidden electric-dipole transitions between the ground and excited states of the even 3d shell of a magnetic ion in antiferrodielectric. The theory allows one to semiphenomenologically take into account a contribution of intermediate states of all odd configurations to an electric-dipole transition. (tr-auth)

10571 (ITF-73-22-P) RESEARCH IN GROUP DECOMPOSITION FOR BINARY DISTRIBUTION FUNCTIONS OF PARTICLE SYSTEMS WITH ELECTROSTATIC INTERACTION. II. The Third Virial Coefficient. Yukhnovskii, I. R.; Golovko, M. F.; Vysochanskii, V. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In the third virial coefficient approximation the curves of the binary distribution function $F_{\pm}$ of ion-dipole systems of three sorts are calculated with various values of molecular and thermodynamical parameters. It is shown that the presence of the compact dipole subsystem leads to ordering in the ion subsystem. The influence of various parameters of intermolecular interaction on the system ordering is discussed. (tr-auth)

10572 (JEN-254) INTEGRATION IN FUNCTIONAL SPACES. Colino, A. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 13p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

10573 (JINR-E12-6778) CORRELATION BETWEEN THE OVERALL STABILITY CONSTANTS OF METAL COMPLEXES. VII. The Effect of Temperature. Mihailov, M. H.; Mihailova, V. Ts.; Khalkin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 17p. Dep. NTIS (U. S. Sales Only).

10574 (JINR-E14-7012) PHONON DENSITY OF STATES AND COHERENT INELASTIC NEUTRON SCATTERING ON COMPLEX STRUCTURES. Eschrig, H.; Feldmann, K.; Hennig, K.; John, W.; van Loyen, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

10575 (JINR-P4-7001) INFRARED ASYMPTOTIC FORM METHOD IN THE ISING MODEL. I. Functional Representation. Zagrebnov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The behavior of the two-point correlation function of spins in the Ising model is considered when the distance between the spins is much greater than the interaction radius. The functional representation, close to the method of calculation of infrared branching in field theory, was used to study the asymptotic forms in the paramagnetic critical region. (auth)

10576 (JINR-P4-7097) SUSCEPTIBILITY OF THE ISING MODEL IN THE WEISS LIMIT. Zagrebnov, V. A.; Brankov, I. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The magnetic susceptibility is studied for a N-body Ising system described by the Hamiltonian: $\mathcal{H} = -J/2N \sum_{i,j} \sigma_i^z \sigma_j^z - \mu h \sum_i \sigma_i^z$. A rigorous proof has been given earlier for the thermodynamical equivalency (in the limit $N \to \infty$) of $\mathcal{H}$ and $\mathcal{H}_0$. In the case of finite N, upper bounds have been found on the difference of the free energies per spin for these systems. (auth)

10577 (JINR-P4-7143) INFRARED ASYMPTOTIC FORM METHOD IN THE ISING MODEL. II. Correlation Function in Critical Region. Zagrebnov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p.

(In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A method similar to the infrared branching investigation in field theory is applied to the problem of evaluation of the critical exponent η_d. Asymptotics in microscopic and macroscopic critical regions are obtained. It is shown that, for dimensions $2 < d < 4$, the asymptotics of pair correlation function is nonclassical. It has a nonzero critical branching exponent η_d in the microscopic region and a temperature deviation factor in the macroscopic one. When d approaches 4, the formal expression for $\eta_d \leq 4$ converges to zero, but the direct calculations demonstrate a logarithmic branching and a temperature renormalization for $d = 4$. For $d > 4$ the pair correlation manifests a classical behavior in the whole critical region. In the intermediate critical region, the asymptotic has a "macroscopic character." The difficulties in the case of $d = 2$ are discussed. (auth)

10578 (JUL-862-AC) AUTOMATIC TIME SWITCH FOR PHOTOGRAPHIC DEBYE–SCHERRER MEASUREMENT OF POWDERED CRYSTALS. Krumpen, P.; Rauschen, M.; Reichert, W. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Analytische Chemie). Jun 1972. 24p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

10579 (JUL-905-FF) NONEQUILIBRIUM PHASE TRANSITION IN AN EXACTLY SOLUBLE LASER MODEL. Dohm, V. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Festkoerperforschung). Dec 1972. 83p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

10580 (KFK-1753) DEFORMATION BEHAVIOUR OF OXIDE-BASE Al_2O_3 CERMETS WITH VARYING Cr CONCENTRATION. Engelhardt, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Jan 1973. 148p. (In German). Dep. NTIS (U. S. Sales Only) $9.50.

Creep experiments were performed with a four-point-load bending machine carried out on pure polycrystalline Alumina and Al_2O_3–Cr cermets (10, 20, 30, 40, and 50 vol % Cr). After powder-technique preparation, grain size of the Al_2O_3 matrix decreased with increasing Cr content. The creep tests were run in the temperature range $1280 < T < 1600$°C with outer fiber stresses in the range $1 < \sigma_e < 7.5$ kp/mm^2. After a period of transient creep, the further deformation was steady-state in all cases. Variations of creep strain rate with stress and temperature were measured using the incremental stress and temperature method. The activation energy for creep deformation of polycrystalline Al_2O_3 was determined. The transition in the stress exponent was also observed in all cermets at almost the same stress range with no change in the activation energy. In contrast to this the activation energy decreases with increasing Cr content. Individual measurements on porous cermets showed, that porosity results in a further increase in the creep rate and it did not reveal any measurable influence on the activation energy for creep. (JCW)

10581 (KFKI-72-72) π-ELECTRON SCF–MO CALCULATIONS FOR DISUBSTITUTED BENZENE DERIVATIVES CONTAINING TWO ACCEPTOR GROUPS. Part II. Numerical Results of Calculations. Kiss, A. I.; Szoke, J. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Jan 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

10582 (LA-5119) ELECTRONIC CONTROL SYSTEM FOR TEMPERATURE REGULATION. Burnett, L. J. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 3p. Dep. NTIS $4.00.

A flowing gas temperature control system is described for regulating temperatures to within ±0.1°C over the range −120°C to +50°C. The operation of the system, which is used to obtain stable sample temperatures during the pulse nuclear magnetic resonance (NMR) measurements, is also described. (auth)

10583 (LA-5225-MS) ONE-DEGREE-OF-FREEDOM MODEL FOR THE TAYLOR INSTABILITY OF AN IDEALLY PLASTIC METAL PLATE. White, G. N. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

An integration of the Prandtl–Reuss elastic–plastic equations for the rate of plastic work permits the use of Miles' energy principle to construct a one-degree-of-freedom model differential equation for the disturbance amplitude in the Taylor instability of a metal plate. The model covers a range intermediate between Miles' infinitesimal model and his rigid-plastic model. This intermediate range of amplitudes proves to be the important region in comparisons with numerical studies of Blewett and Meyer using the complete basic equations. (auth)

10584 (LA-5228) D + ClF_3: MOLECULAR-BEAM KINETICS. Cross, J. B. (Los Alamos Scientific Lab., N. Mex.). May 1973. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

10585 (LA-tr-73-4) INVESTIGATIONS OF THE SPECTRUM OF A HYDROGEN FLUORIDE LASER. Pummer, H. (Max-Planck-Institut fuer Plasmaphysik, Garching (West Germany)). 31 Jan 1972. Translation of IPP-4/31. 51p. Dep. NTIS $4.75.

A pulsed, discharge-initiated hydrogen fluoride laser is described whose maximum energy output is 1.2 Joule with pulses of 400 nsec half-width. Details of the experimental setup are given and spectrum measurements for various conditions of SF_6/H_2 mixing ratios and pressures are reported. Towards lower pressures (~1 torr), the temporal behavior of the spectrum changes markedly and new lines with high rotational quantum numbers build up, indicating that levels with $J > 10$ are substantially pumped. This behavior is compared with the results of a simple mathematical calculation concerning the relaxation of a nonthermal rotational distribution of hf molecules. (auth)

10586 (LA-UR-73-641) MEDICAL AND BIOLOGICAL APPLICATIONS OF STABLE CARBON, NITROGEN, AND OXYGEN ISOTOPES. Tolbert, B. M.; Matwiyoff, N. A. (Los Alamos Scientific Lab., N. Mex.). 22 Mar 1973. Contract W-7405-eng-36. 27p. (CONF-730309-8). Dep. NTIS $3.50.

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

10587 (LA-UR-73-701) SHORT PULSE AMPLIFICATION AND ROTATIONAL RELAXATION IN CO_2 AMPLIFIERS. Schappert, G. T. (Los Alamos Scientific Lab., N. Mex.). 1973. Contract W-7405-eng-36. 5p. (CONF-730515-3). Dep. NTIS $3.00.

From 4th biennial conference on laser engineering and applications; Washington, District of Columbia, USA (30 May 1973).

The general belief is that pulses longer than several rotational relaxation times can extract all the energy available in the vibrational inversion. It is shown that this is incorrect; much longer pulses are required. (auth)

10588 (LBL-1159) MOLECULAR BEAM CHEMISTRY OF ALKALINE EARTH ATOMS. Mims, C. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). May 1973. Contract W-7405-eng-48. 188p. Dep. NTIS $11.25.

Thesis.

An apparatus was constructed for measuring laboratory (LAB) angular distributions of reactively scattered products from crossed neutral molecular beams. Products are detected by electron bombardment ionization and subsequent mass analysis. The reactions of the alkaline earth (Group IIA) metals with HI, ICl, BrCN, SF_6, $SnCl_4$, PCl_3, NO_2, and SO_2 have been studied. In all but the HI reactions, product center-of-mass (CM) recoil energy and angular distributions were fit to the measured LAB distributions by averaging over the measured (nonthermal) beam velocity distributions. Kinematic restraints in the HI reactions, which preclude determination of CM scattering behavior, allow the measurement of the premium which the reaction places on incident relative kinetic energy. (DHM)

10589 (LBL-1168) CHARACTERISTICS OF DISLOCATION GLIDE THROUGH A RANDOM ARRAY OF OBSTACLES. Klahn, D. H.; Morris, J. W. Jr. (California Univ., Berkeley. Lawrence Berkeley Lab.). Nov 1972. Contract W-7405-eng-48. 22p. (CONF-721064-3). Dep. NTIS $3.25.

From John E. Dorn memorial symposium; Cleveland, Ohio, USA (16 Oct 1972).

Characteristics of the thermally activated glide of a dislocation, idealized as a line of constant tension, through a random array of identical, immobile point obstacles under constant applied stress are described. The glide is jerky, the degree principally determined by temperature. The velocity of glide at low to moderate temperature can be fit to an equation of the Arrhenius type only if a pre-exponential function of temperature and stress is incorporated. (auth)

10590 (LBL-1199) KINETICS OF SULFUR DIOXIDE FLUORESCENCE. Martin, D. R. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 128p. Dep. NTIS $8.50.

Thesis.

The fluorescence lifetime of gas-phase sulfur dioxide in the first-excited singlet state was measured over a range of excitation and observation wavelengths and SO_2 pressures. Measurements were made by the phase-shift method. The radiative lifetime of SO_2 was determined at low pressure (less than 0.2 mtorr) for various excitation wavelengths (10 Å, full width at half maximum) from 2500 to 3150 Å and observation over the range 3300 to 4000 Å. The radiative lifetime was observed to vary between 35 and 57 μsec as compared with the lifetime of 0.2 μsec predicted from absorption measurements. (MOW)

10591 (NRC-TT-1620) VACUUM SUBLIMATION OF METAL PHTHALOCYANINES. Al'yanov, M. I.; Borodkin, V. F.; Bender-

skii, V. A.; Khoinov, Yu. I. Translated by V. Poppe from Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 14: No. 10, 1606-1608(1971). 6p. Dep. NTIS (U. S. Sales Only).

10592 (NRC-TT-1631) THERMAL QUENCHING OF LUMINESCENCE AND CONFORMATIONAL TRANSFORMATIONS IN MACROMOLECULES OF SOME POLYMERS. Anufrieva, E. V.; Samokish, V. A.; Serdyuk, I. N.; Eskin, V. E. Translated by V. Poppe (National Research Council of Canada, Ottawa) from Vysokomol. Soedin., Ser. B; 11: No. 2, 114-117(1960). 7p. Dep. NTIS (U. S. Sales Only) $3.00.

The results are described of the investigation of the luminescence of poly(β-naphthyl methacrylate) ($M = 2.6 \times 10^6$) and poly (β-vinyl naphthalene) ($M = 6 \times 10^5$) solutions within a temperature range which included the temperature of conformational transformations in macromolecules. The thermal quenching of luminescence of polymer solutions of the low-molecular analog, β-methyl naphthalene, was also measured. (MOW)

10593 (NRC-TT-1633) RELATIONS BETWEEN EXPOSURES OF SYNTHETIC-FIBRE YARNS TO DAYLIGHT AND TO ARTIFICIAL LIGHT. Winkler, F. Translated by D. A. Sinclair (National Research Council of Canada, Ottawa) from Deut. Textiltech.; 20: No. 11 and No. 12, 722-725; 786-791(1970). 33p. Dep. NTIS (U. S. Sales Only) $3.75.

A method is described for selecting test conditions for an artificial irradiation that would permit a quantitative evaluation of the degree of concordance between the two types of light. (MOW)

10594 (NRC-TT-1635) MOTIONS WITHIN THE EARTH'S CORE. Busse, F. H. Translated by D. A. Sinclair (National Research Council of Canada, Ottawa), from Z. Geophys.; 37: No. 2, 153-177(1971). 30p. Dep. NTIS (U. S. Sales Only) $3.50.

The following topics are discussed: (1) empirical evidence of flows in the earth's core, (2) the dynamo problem, (3) basic equations of hydrodynamics in a rotating system, (4) convection in the earth's core, and (5) flows in the core of the precessing earth. (MOW)

10595 (ORNL-TIRC-73-VB-5) METABOLISM OF FOREIGN COMPOUNDS: AN ANNOTATED BIBLIOGRAPHY. Verbiscar, A. J. (Toxicology Information Response Center, Oak Ridge, Tenn.). Jun 1973. 28p. Dep. NTIS $5.00.

10596 (ORNL-TM-4037) MULTITUBE CONDENSER DATA TABULATION. Eissenberg, D. M. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 383p. Dep. NTIS $21.25.

Addendum to ORNL-TM-4036.

This report serves as an addendum to ORNL-TM-4036 by providing a summary of the experimental data obtained from the multitube steam condenser during its operating period, February 1968 to January 1969. The computer program used for the data analysis, CONTST, was written in Fortran and run on the batch computer at Oak Ridge National Laboratory. It is an expansion of two smaller programs, MULT and TCL, written in BASIC for use on a shared-time computer, and primarily used for data reduction during experimental operation of the equipment. CONTST contains some calculations and subroutines that are not utilized in the final data tabulation. A listing of CONTST appears in Appendix A; a description of the important equations used in the program is given in ORNL-TM-4036. The experimental data are tabulated by run number in Appendix B. Included for each run is a listing of all the temperatures and flow rates recorded during each run including those used to monitor the operation of the loop and not used in data analysis. The tabulated values include those read directly from instruments as well as those reduced by the computer from thermocouple voltages and flowmeter readings. The tabulations for each run contain calculated overall heat transfer coefficients for each instrumented tube, a summary of the pertinent run conditions, and a set of derived heat transfer parameters based on the five tube average heat transfer coefficients which were used in the correlations. (auth)

10597 (ORNL-UR-101) MIGRATION AND FERTILITY: A STUDY OF THE SOCIAL FACTORS INVOLVED. Ritchey, P. N. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 58p. Dep. NTIS $5.00.

10598 (ORNL-UR-102) CHANGES IN POPULATION AND EMPLOYMENT AS PROCESSES IN REGIONAL DEVELOPMENT. Patrick, C. H.; Ritchey, P. N. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 29p. Dep. NTIS $3.50.

10599 (ORNL-UR-103) CORRELATES OF CHILDLESSNESS AND EXPECTATIONS TO REMAIN CHILDLESS: U. S. 1967. Ritchey, P. N.; Stokes, C. S. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 24p. Dep. NTIS $3.25.

10600 (ORNL-UR-104) MEASURING PATTERNS OF URBAN GROWTH. Taeuber, C. M. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 29p. Dep. NTIS $3.50.

10601 (ORNL-UR-105) DECENTRALIZATION OF MANUFACTURING EMPLOYMENT. Patrick, C. H. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 26p. Dep. NTIS $3.50.

10602 (ORNL-UR-108) URBAN CLASSIFICATION SCHEME: THE DEVELOPMENT OF A SIMPLE URBAN MODEL. Williams, M. M. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 24p. Dep. NTIS $3.25.

10603 (ORNL-UR-110) POVERTY AND MIGRATION FROM RURAL TO METROPOLITAN AREAS. Ritchey, P. N. (Oak Ridge National Lab., Tenn.). Jun 1973. 47p. Dep. NTIS $4.50.

There is the widespread view that rural-to-urban migrants are saturating the ghetto areas of large cities and disproportionately contributing to poverty in urban areas. In this paper, data from the 1967 Survey of Economic Opportunity are analyzed to explore both dimensions of the presumed relationship of rural–urban migration and the plight of cities. The findings indicate that urban poverty and the plight of cities are the consequences of broader structural features of our society—the handicaps of age, of being a female head of household, or of the status ascribed to blacks—and not the product of rural–urban migration. (MOW)

10604 (ORNL-UR-112) EFFECTS OF CROWDING AND HIGH POPULATION DENSITY: AN ANNOTATED BIBLIOGRAPHY WITH PERMUTED TITLE AND SIMPLE AUTHOR, TITLE, KEY WORD, AND TAXONOMIC INDICES. Williams, M. M.; Combs, Z.; Edmonds, G. (Oak Ridge National Lab., Tenn.). Jun 1973. Contract W-7405-eng-26. 141p. (ORNL-EIS–72-13). Dep. NTIS $9.25.

10605 (ORO-3662-16) CONJECTURES ON THE PERCEPTION OF ELONGATION. Deutsch, E. S. (Maryland Univ., College Park. Computer Science Center). Feb 1971. Contract AT(40-1)-3662. 27p. (CONF-710986-1). Dep. NTIS $3.50.

From 2nd international joint conference on artificial intelligence; London, UK (Sep 1971).

The problem of perception of length together with some known illusions in this field is discussed. The difference is then drawn between image contraction and image thinning, both processes of which serve to introduce the proposed conjecture. The suggested conjecture is that length is perceived by a mechanism which first forms a minimal closed path (hull) around the object and then performs an isotropic image reduction operation on the hull of the image. It is conjectured that the elongation of the image is exemplified in the resulting path so obtained; no path should result if the original image possesses no elongation. The conjecture is used to explain the known illusions discussed, and a few new ones are suggested. An isotropic image-reduction technique is described, and experimental results testing the conjecture, obtained using a variety of images, are presented. (auth)

10606 (ORO-3947-10) ELEVATED-TEMPERATURE MORPHOLOGICAL STABILITY OF METAL MATRIX FIBER COMPOSITES. Progress Report, February 1, 1972–January 31, 1973. Courtney, T. H. (Texas Univ., Austin. Materials Science Lab.). Feb 1973. 20p. Dep. NTIS $3.00.

10607 (ORO-4202-1) CONTINUATION OF MEASUREMENT OF THIRD-ORDER ELASTIC CONSTANTS OF SOLIDS. Final Technical Report. Breazeale, M. A. (Tennessee Univ., Knoxville. Dept. of Physics). May 1973. Contract AT(40-1)-4202. 3p. Dep. NTIS $3.00.

10608 (RLO–2225-T-21-10) SYNOPTIC MEASUREMENTS OF CURRENTS AND SEDIMENT TRANSPORT ON THE CONTINENTAL SHELF. Sternberg, R. W. (Washington Univ., Seattle. Dept. of Oceanography). 30 Apr 1973. Contract AT(45-1)-2225. 21p. Dep. NTIS $3.25.

10609 (RLO-2225-T-25-8) COLUMBIA RIVER EFFECTS IN THE NORTHEAST PACIFIC: PHYSICAL OCEANOGRAPHY. Progress Report, June 1972–March 1973. Barnes, C. A.; Smith, J. D.; Beck, J. R. (comps.) (Washington Univ., Seattle. Dept. of Oceanography). 25 Apr 1973. Contract AT(45-1)-2225, TA 25. 17p. Dep. NTIS $3.00.

10610 (RLO-2227-T-9-7) PHYSICO-CHEMICAL PROPERTIES OF SOILS FROM VOLCANIC ASH. Final Report. Harward, M. E. (Oregon State Univ., Corvallis (USA). Dept. of Soil Science). 26 Mar 1973. Contract AT(45-1)-2227. 9p. Dep. NTIS $3.00.

10611 (RLO-2227-T-9-8) CATION RETENTION AND SOLUTE TRANSPORT RELATED TO POROSITY OF PUMICEOUS SOILS. Doak, W. H. (Oregon State Univ., Corvallis (USA). Dept. of Soil Science). Jun 1972. Contract AT(45-1)-2227. 116p. Dep. NTIS $7.75.
Thesis.

10612 (SC-DR-720251) DEVELOPMENT OF A LONG-LIFE, WIDE-TEMPERATURE-RANGE BATTERY. Levy, S. C.; Reinhardt, F. W. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 27p. Dep. NTIS $3.50.
Research undertaken to determine the feasibility of using an organic electrolyte battery system to power sensors over a wide temperature range is described. The electrochemical couple lithium/fluorographite in an electrolyte of 20% propylene carbonate/80% tetrahydrofuran/saturated with lithium hexafluoroarsenate has been shown capable of exceeding all electrical and life requirements over the temperature range −10 to +60°C. (auth)

10613 (SC-DR-720656) SUPERCAVITATING DRAG OF UNDERWATER MODELS. Stephenson, A. E. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 13p. Dep. NTIS $3.00.
The results of a study to determine the drag coefficients for various nose shapes operating underwater in cavitated flow at velocities between 150 and 400 fps are presented. (auth)

10614 (SC-DR-720847) CONTROLLED EVALUATION OF SIMPLIFIED CLEANING PROCEDURE. Hof, G. J. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 16p. Dep. NTIS $3.00.
Deletion of four cleaning steps from an eleven-step procedure caused lower water drop contact angles indicating cleaner surfaces on ceramic substrates for vacuum metallization. Tests on metallization and bonding with the substrates were made to determine if contaminants, not detected by the water drop contact angle method, might be present. No evidence was found of inadequate cleaning. (auth)

10615 (SCL-DR-720075) NON-DESTRUCTIVE TESTING OF A PLATED ALUMINUM/STAINLESS STEEL JOINT. Dini, J. W.; Johnson, H. R.; Beeler, G. N. (Sandia Labs., Livermore, Calif.). Apr 1973. 26p. Dep. NTIS $4.00.
Through-transmission ultrasonic (TTU) testing is an important part of the certification process for a structural aluminum−stainless steel electroplated joint. Studies were conducted which verified that TTU can distinguish between bonded and unbonded parts. It was also determined that variations in the plating parameters do not interfere with the TTU result and that TTU, when combined with a heat proof test, can detect surface defect zones. In addition, information was obtained on the effect of the induced variations on the strength of the plated joint. (auth)

10616 (SC-TM-720314) MINIMIZING THE EFFECTS OF ELECTRICAL NOISE. Adams, R. A. (Sandia Labs., Albuquerque, N. Mex.). May 1972. 40p. Dep. NTIS $4.25.
Some causes of electrical noise in test-equipment systems are discussed. Specific design solutions are proposed for the noise problem. (auth)

10617 (SLA-73-151) ISODENSITOMETER APPLICATIONS. Mottern, R. W. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 20p. Dep. NTIS $3.00.
An automatic scanning and recording densitometer is described. Contour mapping of film-density changes in three radiographs illustrates its use. (auth)

10618 (SLA-73-347) VARIATIONS IN THE BEAM CHARACTERISTICS OF A LIDAR SYSTEM. Landry, M. J. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 65p. Dep. NTIS $5.25.
Variations in four beam characteristics of the high repetition rate, giant pulse, ruby laser used in the Sandia Laboratories GB-60B Lidar System were investigated as functions of five laser controllable parameters. Beam characteristics investigated included divergence, intensity distribution, directivity, and consistency of output energy. Variations in the laser-beam characteristics were monitored as functions of ruby rod temperature, ruby rod quality, pumping repetition rate, cavity loss, and pumping energy. Resulting requirements on the pumping repetition rate in order to obtain minimums in laser beam divergence and deviation in the laser output energy were mutually exclusive. These results indicate that a laser oscillator−amplifier system with automatically controllable cavity mirrors would give more consistency in the output energy and intensity distribution than the laser oscillator presently used in Lidar Systems. (auth)

10619 (SLA-73-422) ERROR SOURCES IN ACCELERATION MEASUREMENTS. Walter, P. L. (Sandia Labs., Albuquerque, N. Mex.). May 1973. 23p. Dep. NTIS $3.00.
After identifying many potential sources of error in acceleration measurements, some techniques are recommended for acquiring valid data, including the use of quartz crystals or metallic strain gages for stability in accelerometer construction, and of ferroelectric crystals and semiconductor strain gages for larger signals, higher frequency response, and miniaturization; an RC time constant of no more than 0.4 second for a stable reference zero with ferroelectric-crystal accelerometers; a minimum value for an accelerometer's resonant frequency; and a realistic assessment of what can actually be recorded. (auth)

10620 (TID-26322) THERMODYNAMIC PROPERTY MEASUREMENTS OF SOLID CHROMIUM SESQUIOXIDE AND CHROMIUM IN SOLID ALLOYS WITH IRON AND NICKEL. Mazandarany, F. N. (Michigan Univ., Ann Arbor (USA). Dept. of Materials and Metallurgical Engineering). 1972. Contract AT(11-1)-1791. 177p. Dep. NTIS $11.00.
Thesis.
Thermodynamic activities of Cr and Cr_2O_3 were measured in solid Ni−Cr, Fe−Cr and Fe−Ni−Cr solutions. An electrolytic technique was chosen, using a thoria−yttria solid oxide electrolyte. (28 tables, 32 figures, 90 references) (LMT)

10621 (UCLA-34-P-170-27) COMPLEX ION CHEMISTRY. Progress Report No. 4 and Final Report, July 1, 1971−December 31, 1972. Garner, C. S. (California Univ., Los Angeles. Dept. of Chemistry). 31 Dec 1972. Contract AT(04-3)-34. 39p. Dep. NTIS.
Fifteen new Cr(III) complexes on which papers were published during the report period are listed. The complexes with protonated trien and tetren ligands represent interesting species with the amine ligand exhibiting less than its normal denticity. In addition, a red isomer (probably the 1, 2, 3 or facial isomer) of $Co(NH_3)_3(OH_2)_3^{3+}$ was characterized. The d−d absorption spectra of all new complexes were determined. (DHM)

10622 (UCRL-51355) STUDY OF IRON SULFIDE ($Fe_{1-\delta}S$) ($0.906 \geq 1-\delta \geq 0.893$) USING THE TECHNIQUE OF POLARIZED AND UNPOLARIZED NEUTRON DIFFRACTION. Shideler, J. A. (California Univ., Livermore. Lawrence Livermore Lab.). Apr 1973. Contract W-7405-eng-48. 199p. Dep. NTIS $12.00.
Thesis.

10623 (UCRL-74666) NUMERICAL MODELING OF THE TRANSPORT, DIFFUSION, AND DEPOSITION OF POLLUTANTS FOR REGIONS AND EXTENDED SCALES. Knox, J. B. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Mar 1973. 16p. (CONF-730612-1). Dep. NTIS $3.00.
From 66th annual meeting of the Air Pollution Control Association; Chicago, Illinois, USA (24 Jun 1973).

10624 (UCRL-Trans-10660) CALCULATION OF TRANSIENT MOTIONS IN FRACTURING MEDIA. Bychenkov, V. A.; Gadzhieva, V. V.; Kuropatenko, V. F. Translated from Chislennye Metody Mekh. Sploshnoi Sredy; 3: No. 2, 3-17(1972). 21p. Dep. NTIS.

10625 (UCRL-Trans-10689) DIVERGENT MODIFICATION OF A SCHEME WITH SEPARATE SWEEPS OF THE GAS-DYNAMIC AND THERMAL-CONDUCTIVITY EQUATIONS. Troshchiev, V. E.; Ladagin, V. K. Translated from Chislennye Metody Mekh. Sploshnoi Sredy; 3: No. 5, 68-74(1972). 9p. Dep. NTIS $3.00.
An implicit scheme for the numerical integration of the equations of gas dynamics including thermal conductivity is discussed. This scheme avoids the matrix sweep and is absolutely stable for a fairly broad class of problems encountered in practice. As far as implicit schemes are concerned, this particular scheme is very economical because it employs a separate sweep of the gas-dynamic and thermal conductivity equations. A divergent procedure is constructed for this scheme. Its stability and results are discussed. (MOW)

10626 (UCRL-Trans-10692) KINETIC PROCESSES IN A PHOTOCHEMICAL IODINE LASER. Hohla, K.; Kompa, K. L. Translated from Z. Naturforsch.; 27a: No. 5, 938-947(1972). 25p. Dep. NTIS $3.25.

10627 MINIATURE FAST ANALYZER (26 OCT 1971) (ENGINEERING MATERIALS). (Oak Ridge National Lab., Tenn.). (CAPE-2320).
14 drawings.

10628 VERHANDLUNGEN DER DEUTSCHEN PHYSIKALISCHEN GESELLSCHAFT. (Spring Meeting of the German Physical Society, Freudenstadt, Germany, April 10−15, 1972). Stuttgart; B. G. Teubner (1972). 282p. (CONF-720464-(Absts.)).
From spring meeting of the German Physical Society; Freudenstadt, Federal Republic of Germany (10 Apr 1972).
Abstracts of papers presented at the sessions of the following divisions are included: crystal science, semiconductor technology, thermodynamics, metal physics, low-temperature, high-frequency, and magnetism. (LMT)

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